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NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. WAGAMONS POND (DE00061), DELAWARE --ETC(U)
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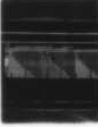
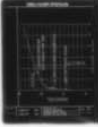
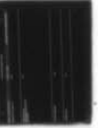
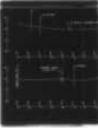
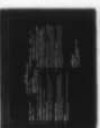
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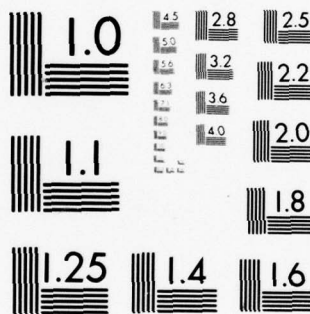
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER DE00061	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Wagamons Pond Dam Sussex County, N.J.	5. TYPE OF REPORT & PERIOD COVERED 9 FINAL rept.	
7. AUTHOR(s) 10 Thomas Tyler/Moore P.E.	8. CONTRACT OR GRANT NUMBER(s) 15 DACW61-78-C-0124	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Moore and Lippincott Engineers ✓ 67 Scotch Rd. Trenton, N.J. 08628	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106	12. REPORT DATE 11 March, 1979	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) 12 128 P	13. NUMBER OF PAGES 92	
	15. SECURITY CLASS. (of this report) Unclassified	
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) 6 National Dam Safety Program, Wagamons Pond (DE00061), Delaware River Basin, Broadkill River Basin, Sussex County, Delaware. Phase I Inspection Report.		
18. SUPPLEMENTARY NOTES Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams Spillways Structural Analysis Safety National Dam Inspection Act Report Wagamons Pond Dam, N.J.		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report. 440 897		



DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE-2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

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Honorable Pierre S. DuPont
Governor of Delaware
Dover, Delaware 19901

24 MAY 1979

Dear Governor DuPont:

Inclosed is the Phase I Inspection Report for Wagonons Pond Dam in Sussex County, Delaware which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Wagonons Pond Dam, a high hazard potential structure, is now judged to be in an UNSAFE, non-emergency condition. Also, the spillway is considered inadequate since two percent of the Probable Maximum Flood would overtop the dam. The dam's stability is considered questionable by the personnel (Consulting Engineer's Staff, State and Federal Engineers) who inspected this structure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within thirty days from the date of approval of this report, the following remedial actions should be completed:

(1) Insert new upstream timber stop logs. The upstream stop logs are presently non-functional. This action will relieve pressure on the downstream stop log guides.

(2) Backfill the sinkhole with suitable material.

b. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the

NAPEN-D

Honorable Pierre S. DuPont

adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

c. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the foundation condition and structural stability of the dam and spillway structure. This should include test borings to determine material properties relative to stability and seepage. A detailed as-built survey of the embankment should also be provided. Any remedial measures found necessary should be initiated within calendar year 1980.

d. Within three months from the date of approval of this report the following actions should be taken:

(1) Repair or replace the deteriorated concrete stop log guide columns.

(2) Repair or replace the downstream embankment retaining walls.

(3) Regrade and stabilize the downstream slope of the embankment near the bridge. Provide slope protection against future erosion.

e. A detailed study of the downstream flooding conditions should be initiated within three months from the date of approval of this report to determine the exact depth and extent of flooding in the town of Milton during high flows.

f. An annual inspection visit should be initiated using a visual check list similar to the one in this report. Water levels in the pond should be monitored during severe storms in order to begin evacuation of flood prone areas in the town of Milton downstream of the dam in the event of a possible overtopping of the dam, or if there are signs of distress in the embankment or spillway.

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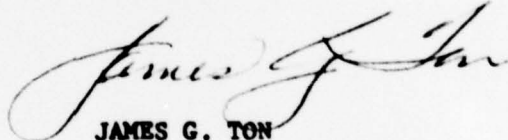
Honorable Pierre S. DuPont

A copy of the report is being furnished to Mr. Austin P. Olney, Delaware Department of Natural Resources and Environmental Control, the designated State Office contact for this Program. Within five days of the date of this letter, a copy will also be sent to Congressman Thomas B. Evans. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, thirty days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Cy furn:
Mr. Austin P. Olney, Secretary
Department of Natural Resources and
Environmental Control

WAGAMONS POND DAM (DE00061)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 4 and 8 December 1978 by Thomas Tyler Moore and Lippincott Engineering Associates, joint venture under contract to the U. S. Army Engineer District, Philadelphia, in accordance with the National Dam Inspection Act, Public Law 92-367.

Inspection of Wagamons Pond Dam on 8 December 1978 by Corps, State, Thomas Tyler Moore and Lippincott Engineering personnel revealed the dam to be in an UNSAFE non-emergency condition. This condition, deteriorated downstream concrete stop log guides and a sinkhole in the downstream slope adjacent to the overflow structure, if left uncorrected, could have resulted in failure of the dam with subsequent possible loss of life and property damage. Until further study could determine the full extent of the problem and possible permanent remedial actions, temporary measures were recommended to preclude serious property damage and possible loss of life. The Governor's representative was notified by telephone of the UNSAFE condition on 12 December 1978. The State Highway Department was notified of the sinkhole on the day of the inspection, 8 December 1978. A letter to the Governor stating the full problem and possible courses of action was sent on 29 March 1979. (Also, an "UNSAFE DAM" data sheet was submitted to the U. S. Army Engineer Division, North Atlantic on 15 December 1978. A copy of this sheet is attached.) The Governor's representative will notify the owner to insert new upstream timber stop logs in order to relieve pressure on the downstream stop log guides. The State Highway Department said that they will fill the sinkhole and keep watch on the sinkhole area.

Wagamons Pond Dam, a high hazard potential structure, is now judged to be in an UNSAFE, non-emergency condition. Also, the spillway is considered inadequate since two percent of the Probable Maximum Flood would overtop the dam. The dam's stability is considered questionable by the personnel (Consulting Engineer's Staff, State and Federal Engineers) who inspected this structure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within thirty days from the date of approval of this report, the following remedial actions should be completed:

(1) Insert new upstream timber stop logs. The upstream stop logs are presently non-functional. This action will relieve pressure on the downstream stop log guides.

(2) Backfill the sinkhole with suitable material.

b. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

c. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the foundation condition and structural stability of the dam and spillway structure. This should include test borings to determine material properties relative to stability and seepage. A detailed as-built survey of the embankment should also be provided. Any remedial measures found necessary should be initiated within calendar year 1980.

d. Within three months from the date of approval of this report the following actions should be taken:

- (1) Repair or replace the deteriorated concrete stop log guide columns.
- (2) Repair or replace the downstream embankment retaining walls.
- (3) Regrade and stabilize the downstream slope of the embankment near the bridge. Provide slope protection against future erosion.

e. A detailed study of the downstream flooding conditions should be initiated within three months from the date of approval of this report to determine the exact depth and extent of flooding in the town of Milton during high flows.

f. An annual inspection visit should be initiated using a visual check list similar to the one in this report. Water levels in the pond should be monitored during severe storms in order to begin evacuation of flood prone areas in the town of Milton downstream of the dam in the event of a possible overtopping of the dam, or if there are signs of distress in the embankment or spillway.

APPROVED:


JAMES G. TON

Colonel, Corps of Engineers
District Engineer

DATE:

18 May 1979



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**DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE-2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106**

29 MAR 1979

**Honorable Pierre S. Dupont
Governor of Delaware
Dover, DE 19901**

Dear Governor Dupont:

This is in reference to our ongoing National Program for Inspection of Non-Federal Dams within the State of Delaware. Wagoners Pond Dam (Federal I.D. No. DE00061), a high hazard potential structure has recently been inspected. The dam is owned by Hudson and Thompson, c/o New Dimensions, Inc. of Delaware, P.O. Box 412, Lewes, Delaware 19958 and is located on the Broadkill River in the town of Milton, Sussex County.

This inspection revealed the dam to be in an UNSAFE, non-emergency condition. Deteriorated concrete stop log guides in the dam's spillway and a sinkhole in the downstream slope of the earth embankment adjacent to the spillway, if left uncorrected, could result in failure of the dam with subsequent possible loss of life and property damage. As a result of this UNSAFE determination, it is recommended that the dam's owner take the following measures within 30 days of the date of this letter:

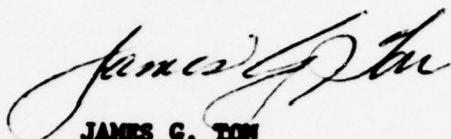
- a. Insert new upstream timber stop logs. The upstream stop logs are presently non-functional. This action will relieve pressure on the downstream stop log guides.
- b. Backfill the sinkhole with suitable material.

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Honorable Pierre S. Dupont

A final report on this Phase I Inspection with a detailed analysis of the situation will be forwarded to you within two months.

Sincerely,



JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies Furnished:

Mr. Austin P. Olney, Secretary
Delaware Department of Natural Resources
and Environmental Control
Edward Tatnall Building
Dover, Dela. 19901

Mr. William R. Ratledge, Director
Division of Soil and Water Conservation
Delaware Department of Natural Resources and
Environmental Control
Edward Tatnall Building
Dover, Dela. 19901

**UNSAFE DAM
NATIONAL PROGRAM OF INSPECTION OF DAMS**

a. **NAME:** Hagamons Pond Dam b. **ID NO.:** DE00061 c. **LOCATION** State: Delaware County: Sussex

d. **HEIGHT:** 10 feet e. **MAXIMUM IMPOUNDMENT**
CAPACITY: Inventory indicates 69 ac. ft. Visual inspection indicates far more. Capacity being verified.

f. **TYPE:** Earth with Concrete Overflow Structure

h. **DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS:** See Item K.

1. **URGENCY CATEGORY:** UNSAFE - Non-Emergency

a. **EMERGENCY ACTIONS TAKEN:**
State Highway Dept. notified day of inspection, 8 Dec 1978 of sinkhole. Highway Dept. stated they fill sinkhole immediately and keep watch on sinkhole area.

b. **REMEDIAL ACTIONS TAKEN:**
Governor's representative will notify owner to insert new upstream timber stop logs. The upstream stop logs are presently non-functional. This action will relieve pressure on downstream stop log guides.

c. **REMARKS:**
As additional actions and information becomes available, this report will be updated.

1. **CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT**
1) Deteriorated downstream concrete stop log guides.
2) Sinkhole in downstream slope adjacent to overflow structure.

j. **DESCRIPTION OF DANGER INVOLVED:** If d.s. stop log guides fail, a 7-foot wide breach could occur. A commercial building located several hundred ft. downstream could possibly be knocked off its pile supports by debris laden waters. This condition would only occur at low. (D.S. area is tidal.)

k. **RECOMMENDATIONS GIVEN TO GOVERNOR:**
Letter being prepared to Governor stating full problem with possible courses of remedial action. Governor's representative informed of situation by telephone on 12 December 1978.

W.H. Zink

W.H. Zink
Coordinator, Dam Inspection Program
U.S.A.E.D., Philadelphia
15 December 1978

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM - Wagamons Pond Dam ID #DE00061

STATE LOCATED - Delaware

COUNTY LOCATED - Sussex

STREAM - Broadkill River

DATE OF INSPECTION - 4 December 1973

* The visual inspection and review of engineering data indicate that Wagamons Pond Dam is in poor overall condition, having a hydraulically inadequate spillway and structural deficiencies. Due to the nature of the structural deficiencies and the possibility of loss of life downstream the Dam is considered unsafe, but a non-emergency condition (failure not imminent).

* The determination that the spillway is hydraulically inadequate was made using the Corps of Engineers screening method procedure. The spillway has the capacity to safely pass one percent (1%) of the Probable Maximum Flood (PMF).

* Those portions of the dam considered structurally inadequate are the concrete piers supporting the stop logs on the downstream side of the bridge/spillway, the downstream embankment retaining walls, and the stop logs on the upstream side of the bridge. Erosion of the embankment under the downstream retaining walls eventually will present a stability problem.

* The stop logs on the upstream side of the bridge/spillway should be replaced immediately.

* The concrete piers should be repaired or replaced very soon.

* The entire downstream slope of the earth embankment near the bridge should be returned to proper grade and stabilized or armored to prevent future erosion soon.

* The downstream embankment retaining walls should be repaired or replaced soon.

* Engineering data relating to the stability of the earthen embankment, downstream retaining walls, and the concrete bridge/spillway should be obtained in the near future.

* A portion of the town of Milton immediately downstream of Wagamons Pond Dam appears to be at an elevation subject to flooding during unusually severe storms. A detailed study of the downstream flooding conditions should be initiated to determine the exact depth and extent of flooding during these high flows. It is recommended that a study of this nature be initiated soon.

* Further studies using more exact procedures are recommended to determine the required spillway size, but it is obvious within the scope of our analysis that additional spillway capacity is required. Permanent modifications and/or additions so as to increase the spillway capacity should be designed soon and constructed in the near future.

In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during severe storms the water levels in the pond should be constantly monitored.

MOORE & LIPPINCOTT - ENGINEERS

Thomas Tyler Moore

Thomas Tyler Moore, P.E.
Project Manager



OVERALL VIEW
OF
DAM

DEC 4, 1978

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ASSESSMENT OF GENERAL CONDITION OF DAM WITH RESPECT TO SAFETY AND RECOMMENDED ACTION WITH DEGREE OF URGENCY

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PLATES

LOCATION MAP
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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigation, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test

6 flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

**PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: WAGAMONS POND DAM**

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. **Authority** - The Dam Inspection Act, Public Law 92-367, dated August 8, 1972, provides for the report herein. The inspection of Wagamons Pond Dam was initiated under Contract DACW61-79-C-006 with the Department of the Army, Philadelphia District, Corps of Engineers by the engineering firms of Thomas Tyler Moore and Lippincott Engineering Associates under a joint venture.
- b. **Purpose of Inspection** - The purpose of the inspection is to evaluate the general condition of Wagamons Pond Dam and bring to the attention of the owner those conditions which are a threat to the public. The National Inventory of Dams will be updated by the data accumulated during this inspection.

1.2 DESCRIPTION OF PROJECT

- a. **Description of Dam and Appurtenances** - Wagamons Pond Dam consists of a concrete bridge/spillway structure located between two short lengths of earth fill embankment dams. Mulberry Street, a paved two-lane public road, runs the length of the bridge and earthen embankments. The spillway consists of wooden stop logs placed in the six openings between concrete piers constructed beneath the bridge. These wooden

NAME OF DAM: WAGAMONS POND DAM

stop logs and concrete piers extend across both the inlet and outlet end of the bridge. The concrete piers supporting the wooden stop logs extend the entire height beneath the bridge between the bridge invert and underclearance. At the time of inspection on December 4, 1978 the stop logs were placed to a height of approximately 5 feet, leaving an opening approximately 4 feet high below the bridge under clearance. Water flowed into the inlet end of the bridge through a gap left in the stop logs at the invert of the bridge. At the outlet end of the bridge this flow of water was directed over the top of the wooden stop logs which were stacked all the way to the invert of the bridge with no significant gaps between the logs. The spillway crest created by these wooden stop logs was approximately 2.5 feet below the low point in Mulberry Street which is located approximately 350 feet south of the bridge/spillway.

A second concrete bridge which is now inoperable is located approximately 300 feet south of the main bridge/spillway. The entire stream channel downstream of this bridge has been filled in up to the top of the dam/roadway elevation, thereby preventing any flow of water through this second bridge.

Wagamons Pond extends 4,000 feet upstream into the Pemberton Branch to the northwest and 3,000 feet upstream into the Ingram Branch to the southwest. A dam has been constructed across the Ingram Branch at Diamond Pond, approximately 4,000 feet upstream of Wagamons Pond Dam. The effect of this dam on flood flows was included in our hydraulic analysis of Wagamons Pond Dam. The Lavinia Causeway is located on the Pemberton Branch approximately 2,000 feet upstream of Wagamons

NAME OF DAM: WAGAMONS POND DAM

Pond Dam. Since this causeway does not constitute a significant restriction to flood flows, the storage volume upstream of the causeway was considered a part of Wagamons Pond. A maximum depth of Wagamons Pond of approximately 5 feet was observed at the bridge/spillway. Approximately 700 feet downstream of Wagamons Pond Dam, Union Street (Route 5) crosses the River. This crossing is in the town of Milton with commercial and residential buildings on both sides of the street extending to the very edge of the river channel.

- b. **Location** - Wagamons Pond Dam is located on the Broadkill River approximately 10 miles upstream of its mouth at the Delaware Bay in Sussex County, Delaware. Wagamons Pond Dam is also immediately upstream and to the west of the town of Milton.
- c. **Size Classification** - The maximum height of the dam is ten feet. The maximum reservoir volume below the low point of the dam is 292 acre-feet. Since the height is less than 40 feet and the storage volume is less than 1,000 acre-feet, the size category of the dam is "Small", as defined by the "Recommended Guidelines for Safety Inspection of Dams".
- d. **Hazard Classification** - Due to the proximity of the commercial and residential buildings along Union Street immediately downstream in the town of Milton, more than a few lives would be lost if the dam should fail. Therefore, this dam is considered in the "High" hazard category as defined by the "Recommended Guidelines for Safety Inspection of Dams."

NAME OF DAM: WAGAMONS POND DAM

- e. **Ownership** - Hudson and Thompson
c/o New Dimensions, Inc. of Delaware
P.O. Box 412
Lewes, Del. 19958
- f. **Purpose of Dam** - The purpose of the dam is to impound water for recreational purposes.

1.3 **PERTINENT DATA**

- a. **Drainage Area** - 22.8 square miles.

- b. **Discharge At Damsite**

Warm water outlet at pool elevation:	None
Diversion tunnel low pool outlet at pool elevation:	N/A
Diversion tunnel outlet at pool elevation:	N/A
Gated spillway capacity at pool elevation:	N/A
Gated spillway capacity at maximum pool elevation:	N/A
Ungated spillway capacity at maximum pool elevation:	9755 cfs
Total spillway capacity at maximum pool elevation:	9755 cfs
Total spillway capacity at top of dam:	243 cfs

- c. **Elevation (feet above Mean Sea Level (M.S.L.))** -

Top Dam:	8.6 ft. M.S.L. (minimum)
Maximum pool-design surcharge:	12.5
Full flood control pool:	N/A
Normal Pool:	6.5 ft. M.S.L. + (includes normal flow over spillway at time of field survey)
Spillway Crest (ungated):	5.4 to 6.5 ft. M.S.L.

NAME OF DAM: WAGAMONS POND DAM

Spillway Crest (gated):	N/A
Upstream portal invert diversion tunnel:	N/A
Downstream portal invert diversion tunnel:	N/A
Streambed at centerline of dam:	1.1 ft. M.S.L.
Maximum tailwater:	Tailwater at high flood flows will be controlled by the culvert and weir flow over the road between buildings at Union Street. Tailwater also subjected to tidal effects.

d. Reservoir (feet) -

Length of Maximum Pool - 5000 feet

Length of Normal Pool - 4000 feet

Length of Flood Control Pool - N/A

e. Storage (acre-feet) -

Normal Pool - 153

Flood Control Pool - N/A

Top of Dam - 292

Design Surcharge - 579

f. Reservoir Surface (Acres) -

Normal Pool - 56

Top of Dam - 68

Flood Control Pool - N/A

Maximum Pool including surcharge - 81

Recreational Pool - 56

NAME OF DAM: WAGAMONS POND DAM

g. **Dam** -

Type - Earth-fill embankments and concrete bridge/spillway

Length - 60 feet of earth-fill, 22 feet of concrete bridge/spillway

Height - 8 to 10 feet

Top Width - 30 feet \pm

Side Slopes controlled by concrete retaining walls

Impervious Core: Unknown

Cutoff: Unknown

Grout Curtain: Unknown

h. **Spillway** -

Type - Wooden stop logs between concrete piers

Length of Weir - 6 openings at 2.75 feet \pm = 16.5 feet total

Crest Elevation - 5.4 to 6.5 feet M.S.L.

Retaining Wall Elevation - varies (see plan)

Gates - None

Upstream Channel - None

Downstream Channel - 21.5 feet concrete channel between wingwalls discharging into river channel

i. **Regulating Outlets** - Wooden stop logs may be added or removed as desired.

j. **Design & Construction** - No written record of the date of original construction was found. A mill at one time existed along the southerly end of the dam. The present owner has informed us the mill was removed approximately in 1972.

No drawings or design data were available.

NAME OF DAM: WAGAMONS POND DAM

SECTION 2 - ENGINEERING DATA

Engineering data in the form of computations or drawings are unavailable. Specific items required to determine the safety of the dam are listed in paragraph 7.1.b.

NAME OF DAM: WAGAMONS POND DAM

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General - Wagamons Pond Dam was found to be in poor overall condition at the time of inspection. The main items requiring repair were deterioration of the concrete piers supporting the spillway and erosion around and under retaining walls.

b. Dam

Earthfill - The sections of earthfill embankment on both sides of the concrete bridge/spillway were fairly short - approximately 30 feet long on each side. No visible signs of movement either vertically or horizontally were evident. The retaining walls supporting the downstream side of the embankment were constructed without retaining wall footings. Erosion of the embankment under all downstream retaining walls was evident. A four foot diameter sinkhole in the south embankment adjacent to the east retaining wall had formed. The sinkhole was approximately 4 feet deep and extended to the bottom of the wall. It appeared that a backwash from the high tide tailwater was drawing the embankment under the retaining wall.

Concrete Bridge/Spillway - Severe deterioration at the base of the concrete piers supporting the wooden stop logs forming the spillway was noted. As much as one-third of the concrete section had deteriorated and some of the reinforcing steel was exposed.

NAME OF DAM: WAGAMONS POND DAM

The stop logs on the upstream side of the bridge/spillway were actually one-half inch thick plywood sheets. Since the water elevation on either side of the half-inch plywood was the same, it is assumed that the plywood has either deteriorated or is just non-existent below the water line. Also, the stop logs should be a minimum of 1½" thick.

The stop logs on the downstream side of the bridge/spillway consisted of 1½" thick planks and appeared to be adequate.

Spalling and deteriorating concrete was noted on the downstream retaining walls. Cracks were visible in most of the downstream walls and appeared structural in nature. No reinforcing steel was visible.

- c. **Appurtenant Structures** - A timber pedestrian walk has been constructed across the river channel along the downstream side of the concrete bridge/spillway. This timber pedestrian walk has handrails and appears to have been constructed recently. It does not appear to have any effect on the operation of Wagamons Pond Dam.
- d. **Reservoir Area** - The reservoir was observed from the dam and from adjacent roadways and upstream road crossings. In general, the banks along the reservoir were well vegetated sloping banks. No unusual erosion was observed. No noticeable siltation of the reservoir was observed.

NAME OF DAM: WAGAMONS POND DAM

- e. **Downstream Channel** - Water flows over the wooden stop logs of the concrete bridge/spillway onto a 22 foot wide concrete apron which is flanked by the wingwalls extending from the bridge/spillway. The downstream river channel immediately below the spillway is in a tidal area and flows downstream approximately 700 feet to Union Street (Route 5) in the town of Milton. The 50 feet \pm wide channel travels between a combination of well vegetated sloping banks, bulkheads, and exposed building walls. No accumulation of debris or other restrictions were observed in this channel. Within the town of Milton there are approximately 15 residential and commercial buildings along Union Street which appear to be in an area which would be subject to flooding during severe storms.

3.2 **EVALUATION**

- a. **Earthfill Embankment** - The erosion around and under the concrete retaining walls is completely unacceptable. This condition increases the hazard of a dam failure should this section of the embankment be overtopped during a severe flood.
- b. **Concrete Bridge/Spillway** - The deteriorated concrete at the base of the concrete piers supporting the wooden stop logs is also completely unacceptable. The increased hydraulic pressure produced by higher flood elevations in the lake could cause a sudden failure of this spillway section.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Wagamons Pond Dam is operated by the owners whose office is in Lewes, Delaware, which is approximately 10 miles east of Wagamons Pond Dam. The lake level is controlled by adding or removing wooden stop logs in the spillway. The normal water surface in the lake is kept fairly uniform except when it is periodically lowered so that the grass growing in the lake may be cut to minimize its clogging effect on the lake.

4.2 MAINTENANCE OF DAM

No formal or systematic maintenance program exists at the present time. During inspection of the dam on December 4, 1978 there did not appear to be any significant maintenance which had recently been performed on the concrete bridge/spillway.

4.3 MAINTENANCE OF OPERATING FACILITIES

Replacement of wooden stop logs as they become weakened through age or use is on an "as needed" basis.

4.4 DESCRIPTION OF A WARNING SYSTEM IN EFFECT

Although this dam is near a developed area and subject to observation from adjacent residents and travelers using Mulberry Road which passes along the top of the dam, there is no formal warning system in effect should the dam be in danger of overtopping.

NAME OF DAM: WAGAMONS POND DAM

4.5 EVALUATION

No records of maintenance or modifications to the embankment or concrete bridge/spillway are available. It is recommended that an annual inspection be initiated by the owner using the federal visual inspection forms included in the appendix of this report.

Construction repair details and/or computations should be kept as a matter of record and all such remedial design and repair should be performed by a professional engineer having experience in the design and construction of dams.

SECTION 5 - EVALUATION OF HYDROLOGIC AND HYDRAULIC FEATURES

5.1 EVALUATION OF FEATURES

- a. Design Data - No design data were available for either the hydrology of the watershed or the capacity of the spillway. For hydrologic evaluation, watershed parameters measured from USGS 7.5 minute quadrangles were used with Snyder coefficients and loss rates specified by the Corps of Engineers to compute peak inflows to the reservoir. The HEC-1 DB computer program was used.

The dimensions of the dam and the spillway were obtained from a field survey. Spillway capacity was calculated from this survey information by standard engineering methods. The relevant data for the Union Street bridge was also measured since this represents a restriction to flow which would control the tailwater at the dam. Additional data needed to determine the extent of this restriction for higher flood flows, such as 0.5 PMF, was not obtained at this time for the following reasons:

1. It was felt that a more detailed gathering of data and subsequent engineering calculations was beyond the original scope of this Phase I study.
2. The purpose of the Phase I study with respect to the hydraulic capacity of the spillway is to determine if the spillway will safely pass a Spillway Design Flood (SDF). It was possible to reach the conclusion that the spillway of Wagamons Pond Dam is hydraulically inadequate without obtaining additional data concerning the buildings which would restrict flow over Union Street. A discussion of these findings is included in Section 7.1 a.

NAME OF DAM: WAGAMONS POND DAM

Based upon the hazard potential classification for this dam the recommended spillway design flood is $\frac{1}{2}$ PMF to PMF. For evaluating the adequacy of the spillway $\frac{1}{2}$ PMF was used as the SDF.

b. **Experience Data**

No measurements of outflows from the dam or flows within the watershed of the dam are available. Local officials do report, however, that although the dam was overtopped during a severe storm in the early 1970's, there was no damage done to the dam. There is a streamflow gaging station 2.5 miles north of Wagamons Pond Dam on another tributary of the Broadkill River. This gaging station is USGS Station Number 01484300 Sowbridge Branch near Milton, Delaware. Based upon 22 years of record, the maximum discharge was 134 cfs for a 7.1 mi² watershed.

- c. **Overtopping Potential** - From the HEC-1 DB Program, the peak $\frac{1}{2}$ PMF inflow into Wagamons Pond equals 9757 cfs. This would produce a peak outflow of 9755 cfs. The spillway capacity at the top of dam elevation 8.6 is 243 cfs. A rating curve for the spillway and a graph summarizing peak inflows and outflows is included in Appendix D. This peak outflow of 243 cfs is equal to 1% PMF, hence the dam would be overtopped by floods greater than 1% PMF. The water level in the pond would have to reach elevation 12.5 to pass $\frac{1}{2}$ PMF. This would overtop the low point of the dam by 3.9 feet. All flood routing calculations included a routing through both Wagamons Pond and Diamond Pond. Diamond Pond is upstream of Wagamons Pond.

NAME OF DAM: WAGAMONS POND DAM

- d. **Emergency Drawdown** - The water in the pond may be drained by removing the wooden stop logs from the spillway. The maximum flow thru the spillway area would be about 490 cfs with the water surface at normal pool Elevation 6.5. With no inflow it would take at least 14 hours to drain the reservoir.

NAME OF DAM: WAGAMONS POND DAM

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observations - Severe deterioration at the base of the concrete piers, supporting the stop logs of the overflow structure, was noted. As much as one-third of the concrete section had deteriorated.

The stop logs on the West face of the bridge/spillway (upstream) were actually 1/2 inch thick plywood sheets. Since the water elevation on either side of the 1/2 inch plywood was the same, it is assumed that the plywood has either deteriorated or is just non-existent below the water line. Also, the stop logs, at a minimum should be 1 1/2 inches thick.

The stop logs, on the East face of the bridge/spillway (downstream), consisted of 1 1/2 inch thick plank and appeared adequate.

The retaining walls, supporting the East (downstream) side of the embankment, were constructed without retaining wall footings. Erosion of the embankment under all downstream retaining walls was evident.

Spalling and deteriorating concrete was noted on the downstream retaining walls. Cracks were visible in most all of the downstream walls and appeared structural in nature. No reinforcing steel was visible.

A 4 foot diameter sinkhole in the south embankment, adjacent to the East retaining wall, had formed. The sinkhole was approximately 4 foot deep and extended to the bottom of the wall. It appeared that a backwash from high tide tail water was drawing the embankment under the retaining wall.

NAME OF DAM: WAGAMONS POND DAM

- b. **Design and Construction Data** - Stability calculations for the dam do not exist.

Insufficient engineering data is available to make an accurate independent assessment of the embankment and spillway structure. The stability of the embankment and spillway structure should be verified on the basis of appropriate engineering parameters.

A continuing deterioration process has reduced the thickness of the concrete piers supporting the stop logs on the downstream side of the spillway by as much as $1/3$. Therefore, the structural capacity of the piers has been reduced by at least $1/3$. Preliminary calculations indicate that $1/2$ inch thick stop logs on the upstream side of the spillway are structurally inadequate to span between supporting piers.

- c. **Operating Records** - Operating records have not been kept for Wagamons Pond Dam.

- d. **Post-Construction Changes** - Modifications to the embankment and bridge/spillway are not evident. According to the Delaware State Department of Transportation, a mill existed approximately 300 feet south of the bridge/spillway now under study. The mill was powered using water supplied by a bridge/spillway on Mulberry Street. The mill and spillway are shown in an aerial photo enclosed in this report. The mill has since been removed and the spillway filled in, up to the bridge. Thus, the effective spillway capacity of the dam has been reduced.

NAME OF DAM: WAGAMONS POND DAM

- e. **Seismic Stability** - Wagamons Pond Dam is located in Zone 1 on the Seismic Zone Map of the United States. Experience has shown that structures located in Zone 1, having adequate stability under static loading conditions, will also have adequate stability under seismic activity. Therefore, that portion of the dam considered unstable, i.e., structurally inadequate, are considered inadequate to sustain seismic loading.

NAME OF DAM: WAGAMONS POND DAM

SECTION 7 - ASSESSMENT/RECOMMENDATIONS,
PROPOSED REMEDIAL MEASURES

7.1 DAM ASSESSMENT

- a. **Safety** - The dam has been inspected visually, in accordance with procedures stipulated by the Corps of Engineers for a Phase I Report. Since no engineering data were available for review, our assessment is subject to those limitations inherent in a visual inspection.

The concrete piers on the downstream side of the spillway (supporting the wooden stop logs), exhibit serious signs of deterioration at the base. If this condition is left uncorrected, a failure will occur, resulting in loss of life downstream. Thus, the dam is considered unsafe, but a non-emergency condition.

The spillway at maximum capacity can pass 1% PMF without overtopping the low point of the dam. This is less than the Spillway Design Flood which is $\frac{1}{2}$ PMF.

Although Wagamons Pond Dam is considered a high hazard dam (See Section 1.2d), a visual examination of the area, together with reports of a previous overtopping of the dam indicates that the area along Union Street below the dam will be flooded prior to failure of the dam. Since this represents no significant increase to the hazard to loss of life downstream, the spillway at Wagamond Pond Dam is classified as inadequate as determined by the guidelines in ETL 1110-2-234.

NAME OF DAM: WAGAMONS POND DAM

- b. **Adequacy of Information** - No information is available for our review to assess the safety of the dam.

To assess the safety of the embankment, the following information is required:

1. Subsurface investigation (soil borings) to determine the soil stratigraphy and develop engineering parameters such as strength, permeability and groundwater level.
2. A detailed as-built survey of the embankment, coordinated with the subsurface investigation, to obtain an accurate assessment at each cross-section.
3. A stability analysis incorporating the phreatic surface through the embankment along the most critical section should be performed.

To assess the safety of the concrete bridge/spillway structure, the following information is required:

1. Engineering parameters of the existing concrete, i.e. compressive strength, reinforcing size, and location.
2. Foundation type and size as well as soil parameters.

c. **Urgency**

The stop logs on the upstream side of the bridge/spillway should be replaced immediately.

NAME OF DAM: WAGAMONS POND DAM

- The concrete piers should be repaired or replaced very soon.
- The entire downstream slope of the earth embankment near the bridge should be returned to proper grade and stabilized or armored to prevent future erosion soon.
- The downstream embankment retaining walls should be repaired or replaced soon.
- Engineering data relating to the stability of the earthen embankment, downstream retaining walls, and the concrete bridge/spillway should be obtained in the near future.
- A portion of the town of Milton immediately downstream of Wagamons Pond Dam appears to be at an elevation subject to flooding during unusually severe storms. A detailed study of the downstream flooding conditions should be initiated to determine the exact depth and extent of flooding during these high flows. It is recommended that a study of this nature be initiated soon.
- Further studies using more exact procedures are recommended to determine the required spillway size, but it is obvious within the scope of our analysis that additional spillway capacity is required. Permanent modifications and/or additions so as to increase the spillway capacity should be designed soon and constructed in the near future.
- In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during severe storms the water levels in the pond should be constantly monitored.

NAME OF DAM: WAGAMONS POND DAM

d. **Necessity for Additional Data/Evaluation**

As demonstrated in Section 7.1 - a. and b., additional data and evaluation is necessary.

7.2 REMEDIAL MEASURES

a. **Alternatives**

Following the more detailed tailwater study recommended in Section 7.1C, a further study of increasing the spillway capacity should consider the following alternatives:

1. As a temporary measure until permanent repairs and/or modifications are made, consideration should be given to draining the lake in order to increase both storage capacity for flood control and the capacity of the outlet thru the spillway area.
2. Construction of an additional spillway.
3. Raising the embankment height to provide additional storage volume and spillway capacity.
4. Armoring and hardening the present embankment to prevent failure during overtoppings.
5. Replacing the existing wooden stop logs with flash boards designed to fail during a severe storm, thereby increasing spillway capacity.
6. A combination of any of the above methods.

NAME OF DAM: WAGAMONS POND DAM

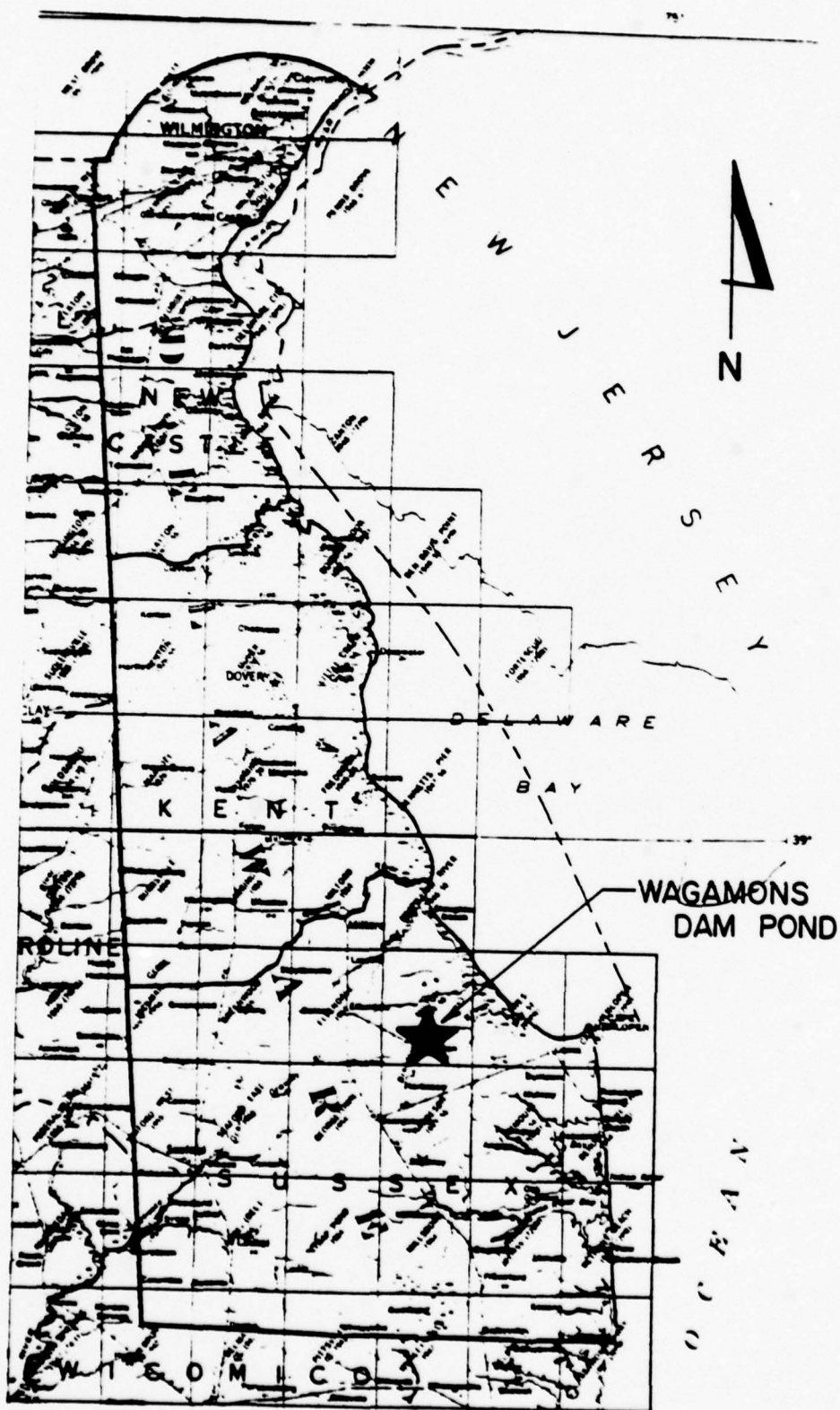
Tailwater elevations, created by downstream restrictions, when determined by the more detailed study, may affect the consideration of items #2, 3 and 5.

- b. **O & M Maintenance Procedures** - An annual inspection visit should be initiated using a visual check list similar to the one enclosed in this report.

Local officials should appoint an organization to monitor water levels in the pond during severe storms and to begin evacuation of flood prone areas in the town of Milton downstream of the dam in the event of a possible overtopping of the dam, or if there are signs of distress in the embankments or spillway.

NAME OF DAM: WAGAMONS POND DAM

PLATES



LOCATION MAP

WAGAMONS POND DAM

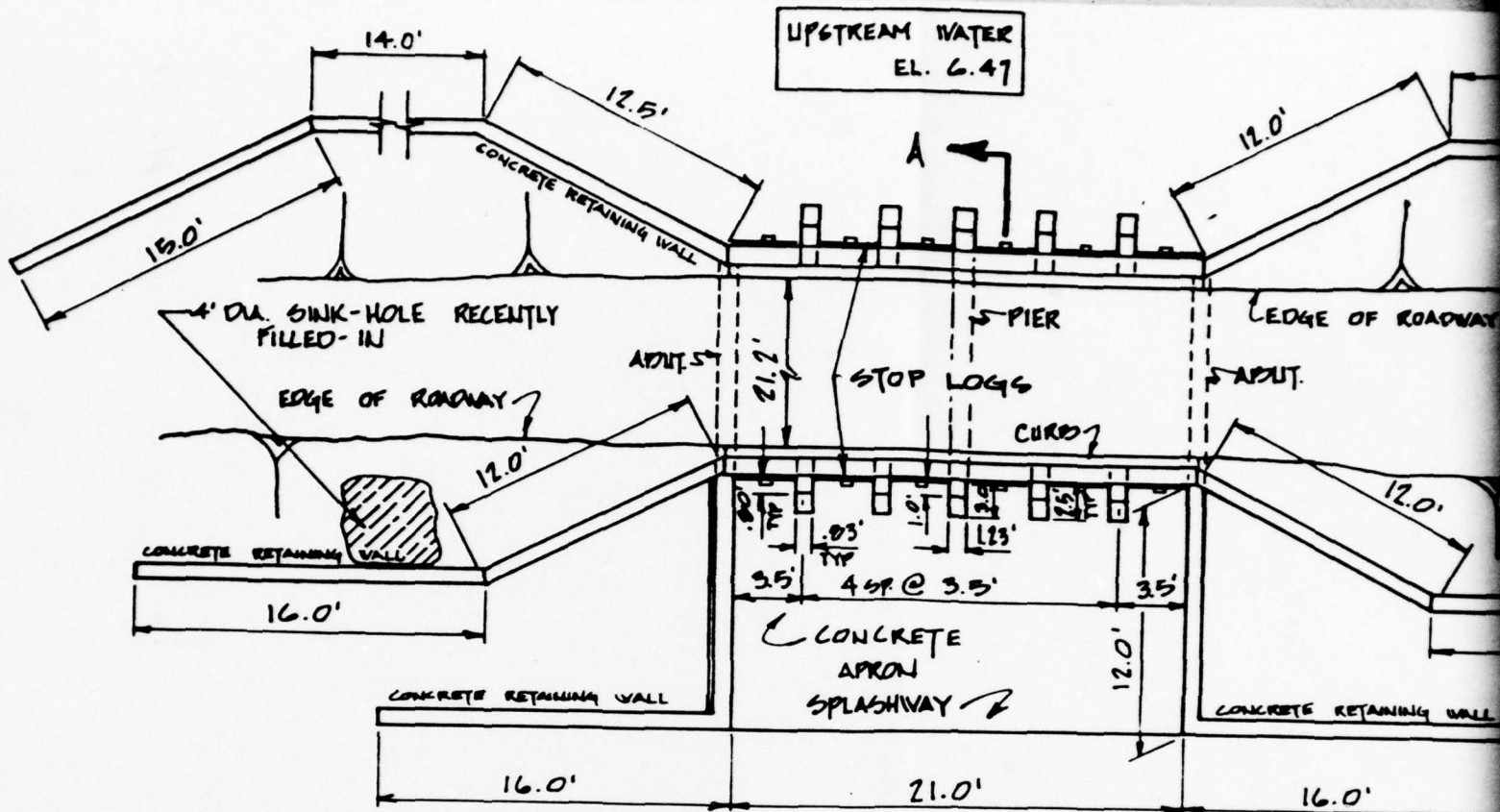
○

ACCORDING TO OUR PHONE CONVERSATION WITH ROBERT R. JORDAN,
STATE GEOLOGIST WITH THE DELAWARE GEOLOGICAL SURVEYS, THE
GEOLOGY OF THE SUSSEX COUNTY AREA HAS NOT BEEN MAPPED FOR
PUBLICATION AS OF THE WRITING OF THIS REPORT.

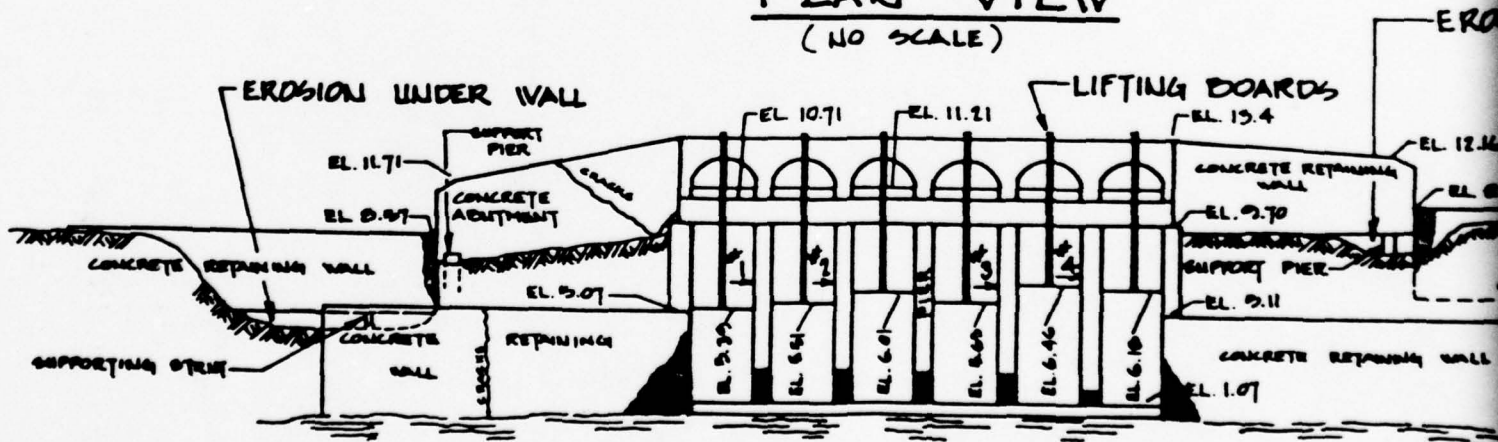
GEOLOGIC INFORMATION

○

PLATE 5



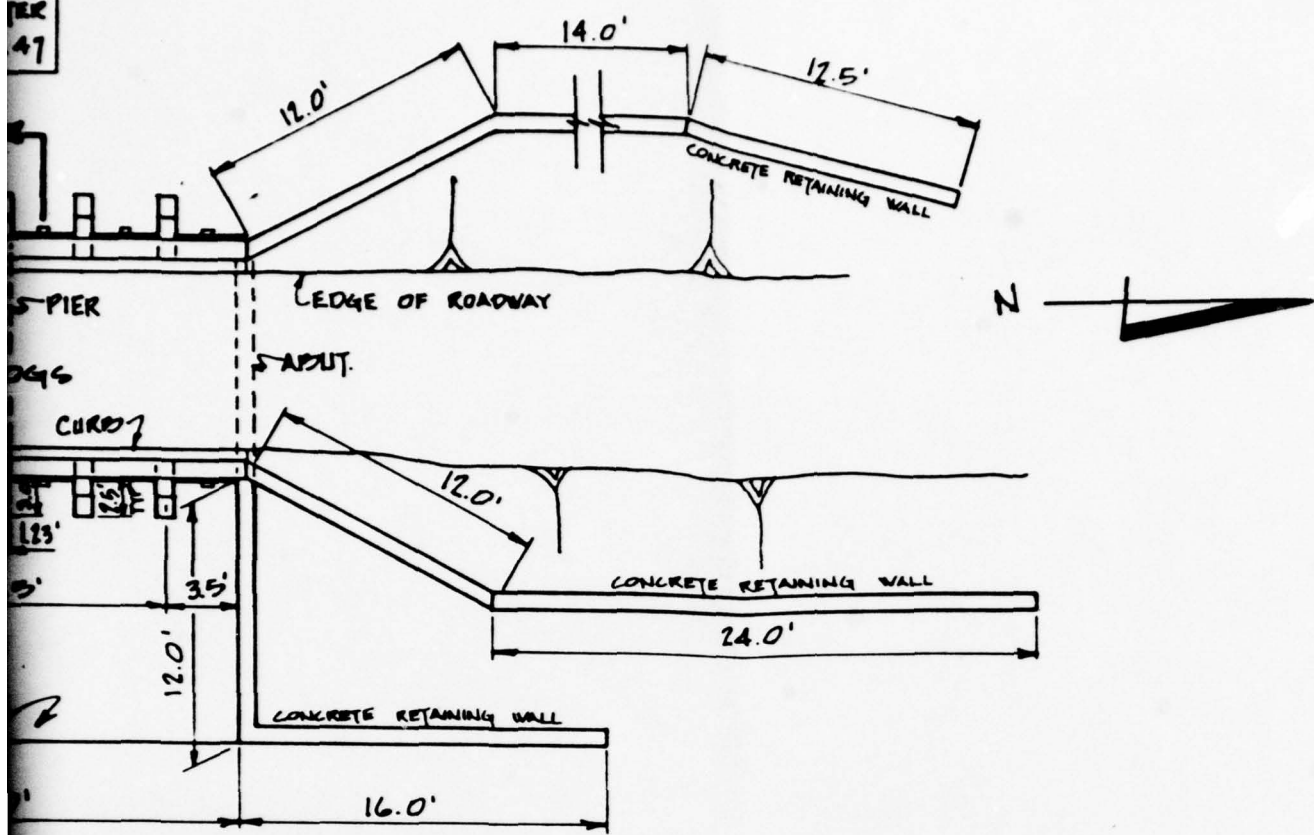
PLAN VIEW
(NO SCALE)



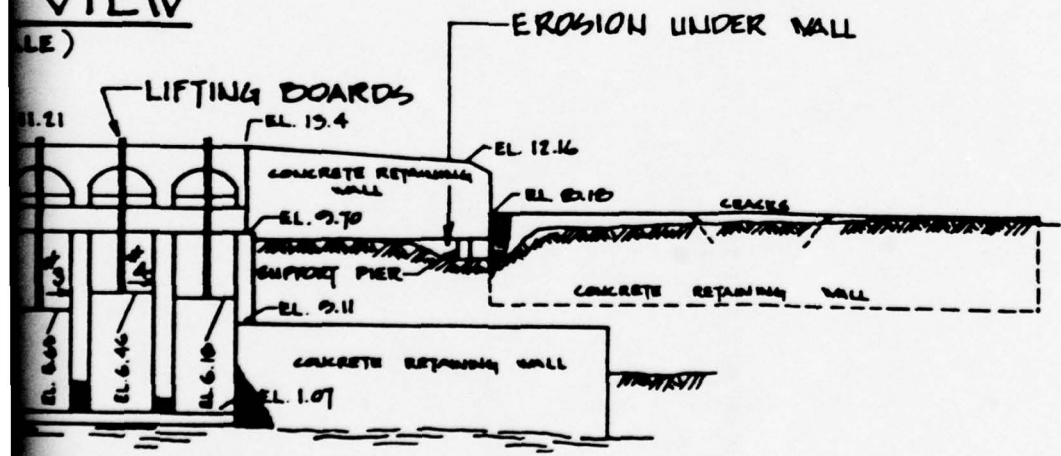
■ DENOTES CONCRETE
DETERIORATION

FRONT ELEVATION
(NO SCALE)

PER
47



VIEW



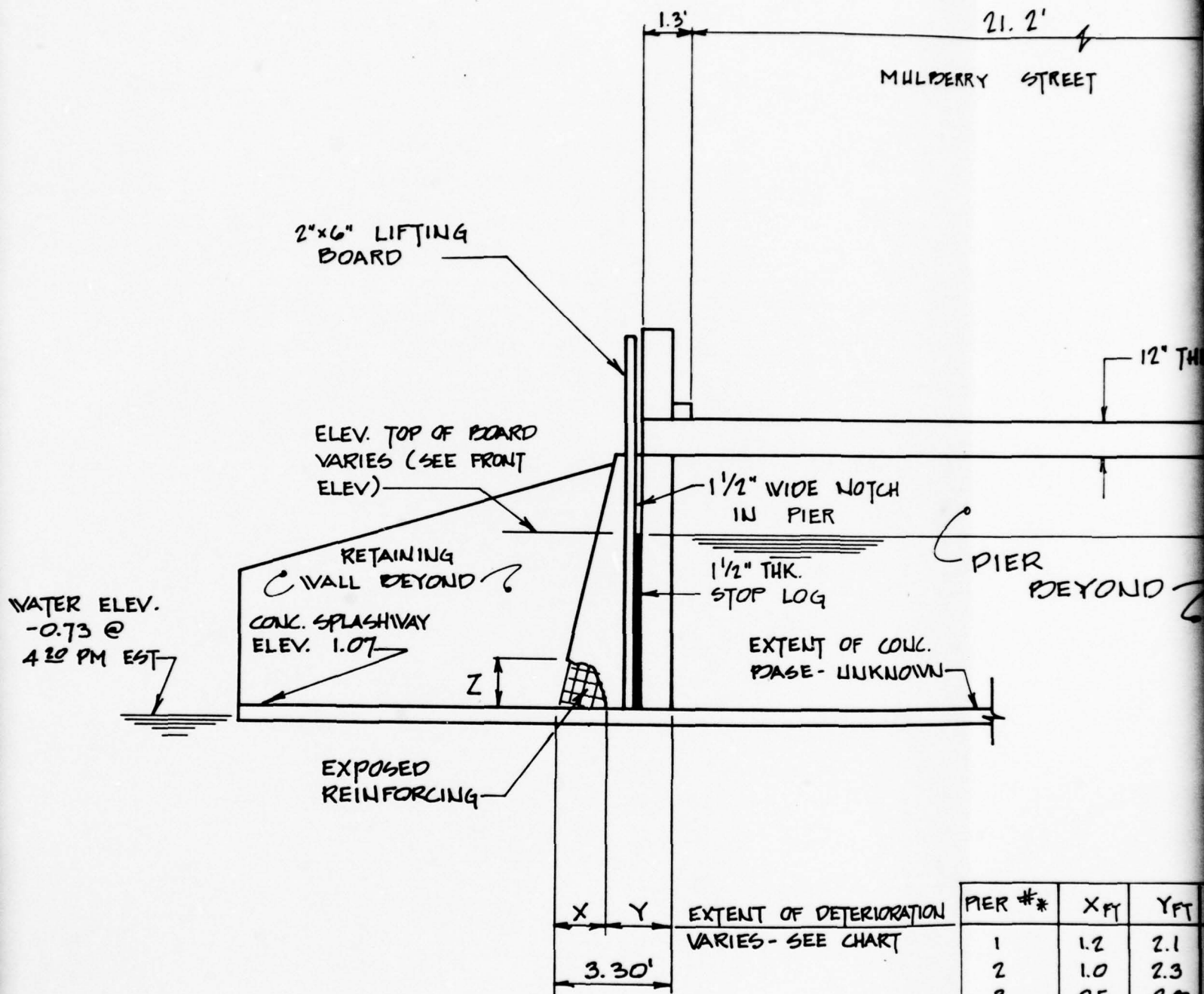
ELEVATION

WAGAMONS POND

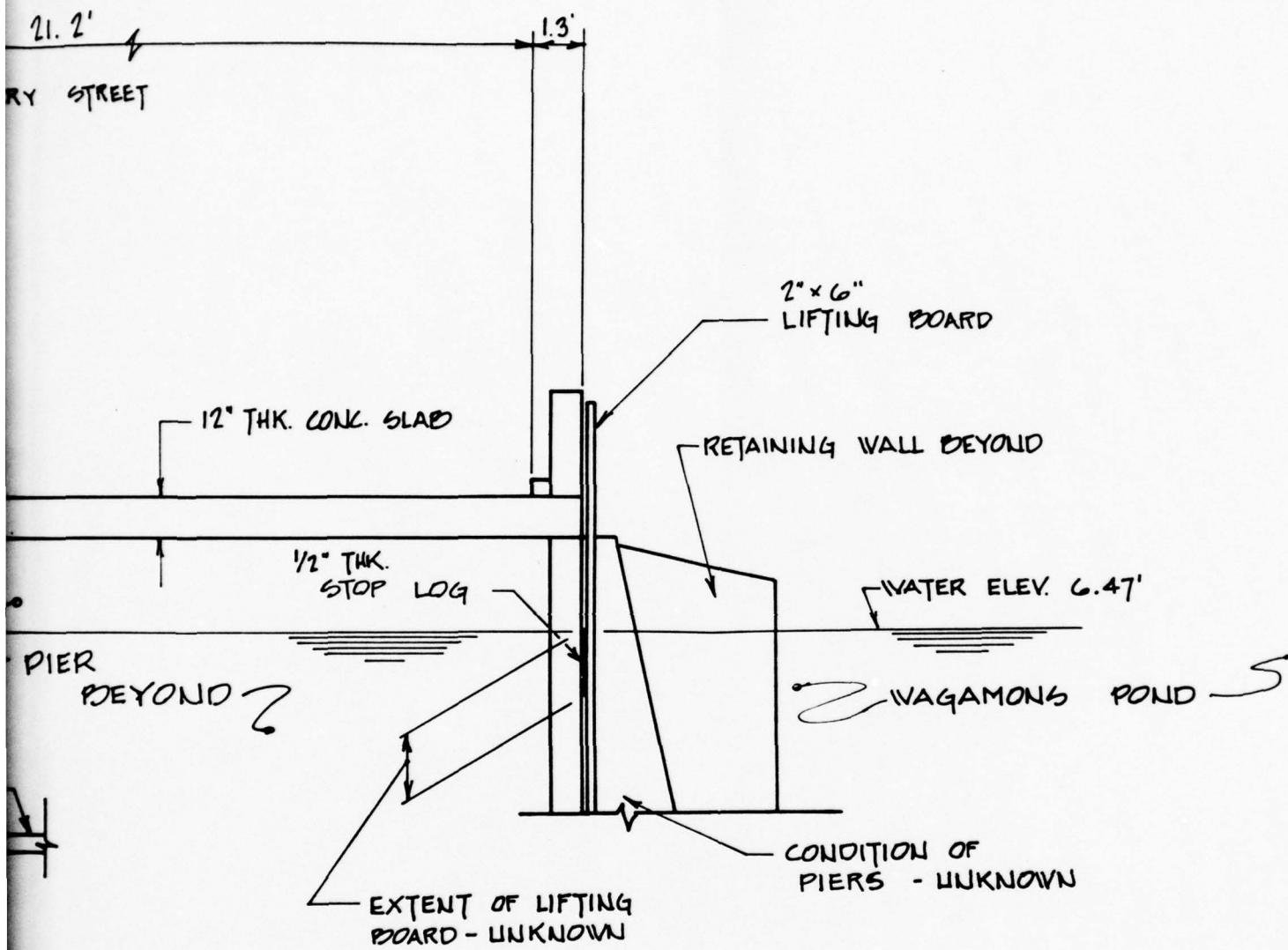
PLATE 2

2

51



* SEE FRONT ELEV. ORIENTATION



SECTION "A-A"

WAGAMONS POND

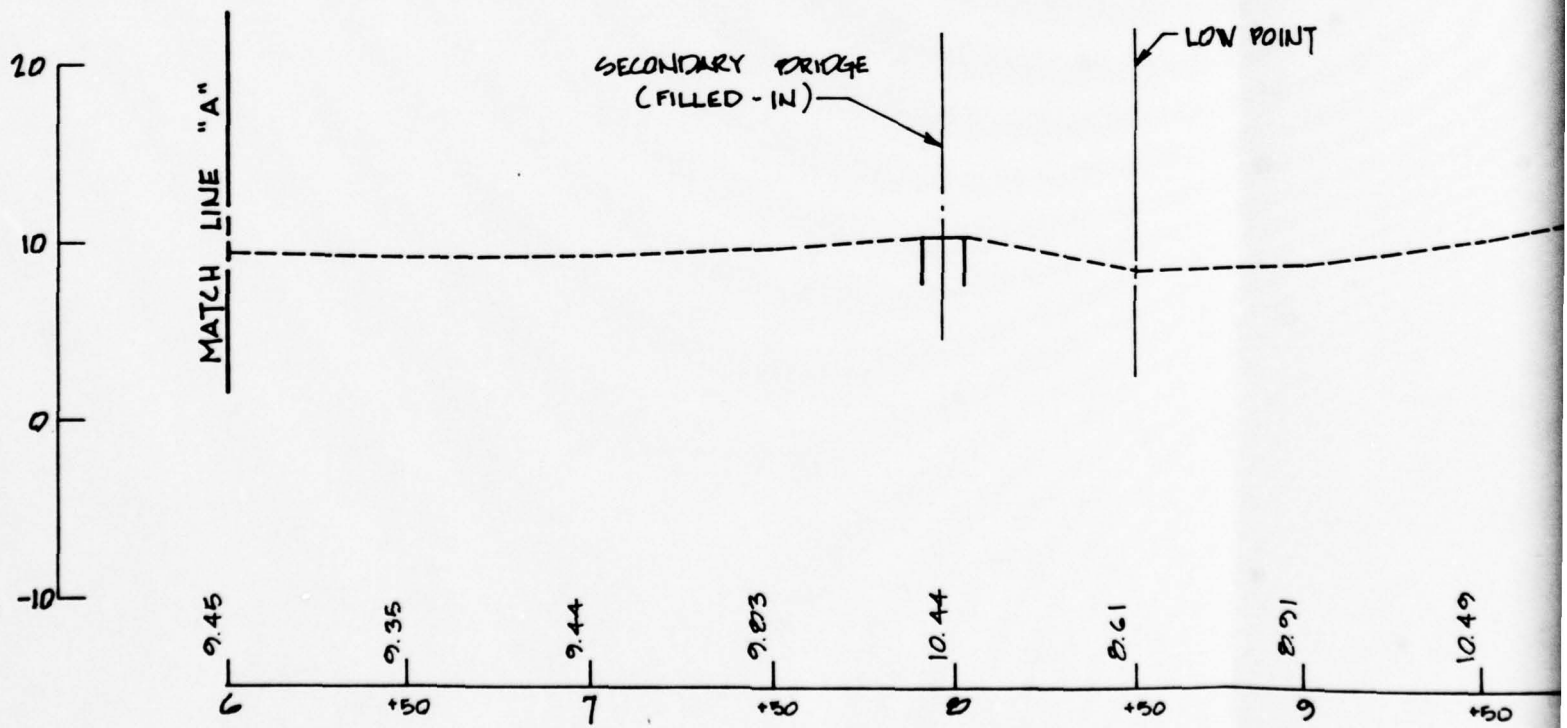
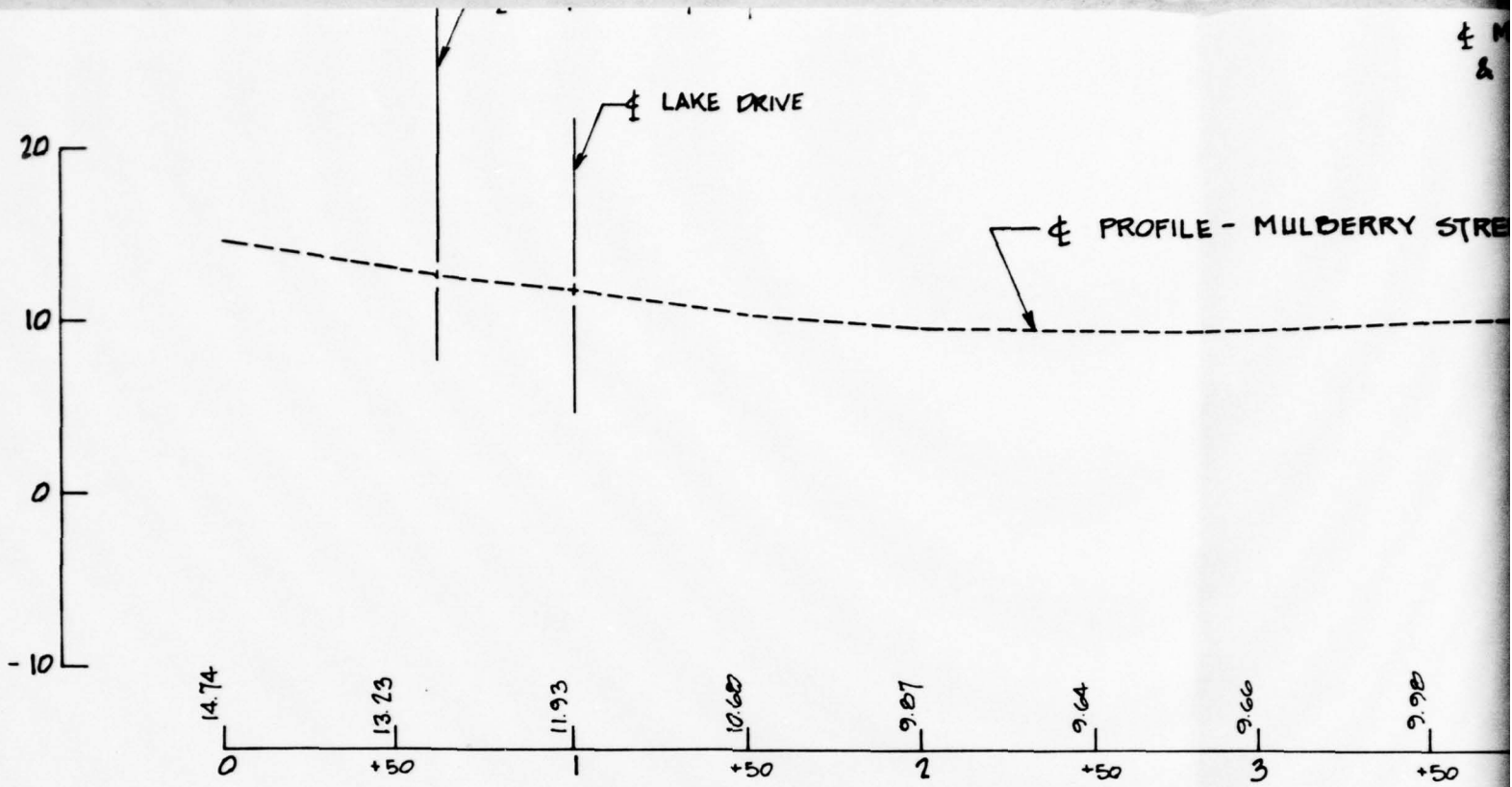
SCALE: 1/4" = 1'-0"

PIER #	X FT	Y FT	Z FT
1	1.2	2.1	1.5
2	1.0	2.3	1.0
3	0.5	2.0	0.33
4	0.2	3.1	0.17

* SEE FRONT ELEV. FOR ORIENTATION

2

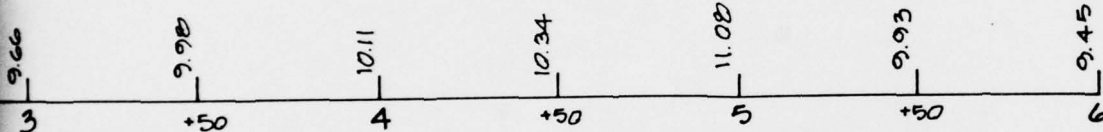
PLATE 3



± MULBERRY STREET BRIDGE (BOB)
& WAGAMONS POND SPILLWAY

MULBERRY STREET

MATCH LINE "A"

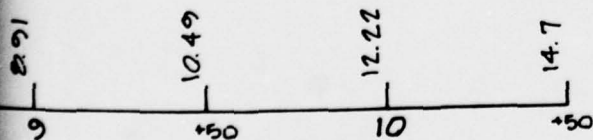


POINT



± PROFILE OF MULBERRY STREET (WAGAMONS POND)

SCALE: HORIZ. 1" = 50'
VERT. 1" = 10'



2

PLATE 4

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

**CHECK LIST - ENGINEERING, CONSTRUCTION
MAINTENANCE DATA**

Check List
Visual Inspection
Phase 1

Name Dam Wagamons Pond Dam County Sussex State Delaware Coordinates: Lat: 38° 46.6'
~~Coordinates~~ Long: 75° 18.8'

Date(s) Inspection 12-4-78 Weather Cloudy Temperature 45°

Pool Elevation at Time of Inspection 6.5 M.S.L. Tailwater at Time of Inspection -0.7 M.S.L.

Inspection Personnel:

Joseph Mahan _____

Jerry Weintraub _____

Jerry Weintraub _____ Recorder

CONCRETE/MASONRY DAMS

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

N/A

SEEPAGE OR LEAKAGE

N/A

STRUCTURE TO
ABUTMENT/EMBANKMENT
JUNCTIONS

N/A

WATER PASSAGES

N/A

FOUNDATION

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None Observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None Observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Erosion and Undermining of concrete retaining walls on both north and south sides of bridge, downstream side. Sink hole eroded behind south, downstream retaining wall from top of embankment to below bottom of wall.	Entire downstream slope of embankment near bridge should be returned to proper grade and stabilized or armored to prevent future erosion.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	None Observed	
RIPRAP FAILURES	None Observed	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Erosion and Undermining of concrete retaining walls on both north and south sides of bridge, downstream side. Sink hole eroded behind south, downstream retaining wall from top of embankment to below bottom of wall.	Entire downstream slope of embankment near bridge should be returned to proper grade and stabilized or armored to pre- vent future erosion.
ANY NOTICEABLE SEEPAGE	None Observed	
STAFF GAGE AND RECORDER	None Observed	
DRAINS	None Observed	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N/A	
INTAKE STRUCTURE	N/A	
OUTLET STRUCTURE	N/A	
OUTLET CHANNEL	N/A	
EMERGENCY GATE	Wooden lifting boards could be removed by lifting 3"x6" vertical control boards.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Weir consists of wooden lifting boards between concrete piers. Boards are lifted by 3"x6" vertical slotted post.	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	Discharge from weir onto concrete splash pad between retaining walls, then into main river channel.	
BRIDGE AND PIERS	Concrete disintegrated and reinforcing steel exposed at base of concrete piers and bridge deck.	Concrete piers and bridge must be repaired or replaced.

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Average 3 horizontal to 1 vertical slopes, well vegetated.	
SEDIMENTATION	None Observed	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Clear of debris. River banks sparsely rip-rapped.	
SLOPES	Moderate slopes.	
APPROXIMATE NO. OF HOMES AND POPULATION	Town of Milton - Population 1,390 Approximately 15 residential and commercial buildings appear to be in a flood-prone area.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None Observed	
OBSERVATION WELLS	None Observed	
WEIRS	Weirs created by wooden lifting boards are not gaged.	
PIEZOMETERS	None Observed	
OTHER	None Observed	

**CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION**

ITEM	REMARKS
PLAN OF DAM	None Available; Plan enclosed in this report based on our survey
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	No records to account for the construction history of the dam are available
TYPICAL SECTIONS OF DAM	None available; Sections enclosed in this report based on our survey
HYDROLOGIC/HYDRAULIC DATA	None Available
OUTLETS - PLAN <ul style="list-style-type: none"> - DETAILS - CONSTRAINTS - DISCHARGE RATINGS 	None Available
RAINFALL/RESERVOIR RECORDS	None Available

ITEM	REMARKS
DESIGN REPORTS	None Available
GEOLOGY REPORTS	"
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	"
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	"
POST-CONSTRUCTION SURVEYS OF DAM	"
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	Records not available
HIGH POOL RECORDS	None
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Local officials report dam overtopped during major storm in early 1970's.
MAINTENANCE OPERATION RECORDS	None Available

ITEM	REMARKS
SPILLWAY PLAN	None Available; drawings enclosed in this report based upon our survey.
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	None

APPENDIX B

PHOTOGRAPHS

PHOTOS TAKEN DURING DECEMBER, 1978



PHOTO 1



PHOTO 2

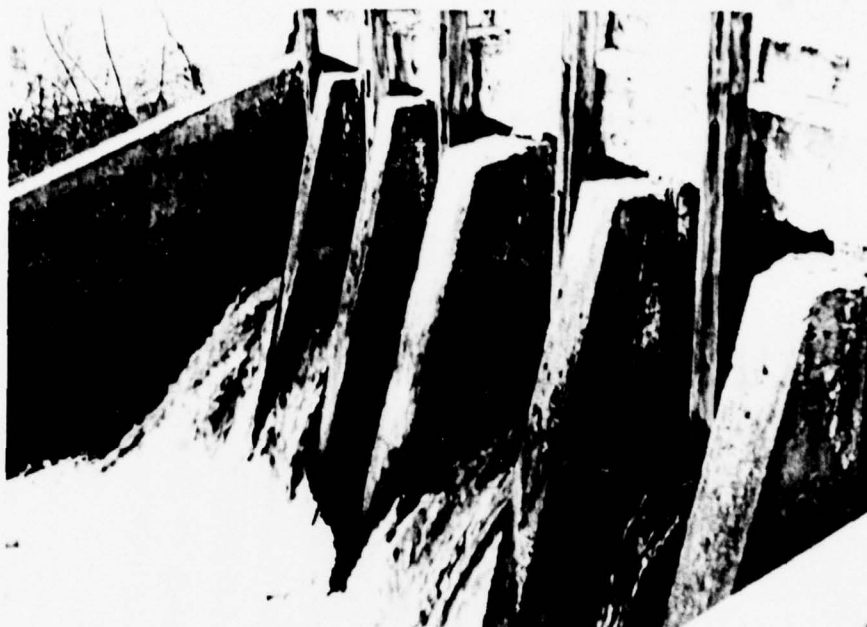


PHOTO 3



PHOTO 4



PHOTO 5



PHOTO 6



PHOTO 7



PHOTO 8



PHOTO 9

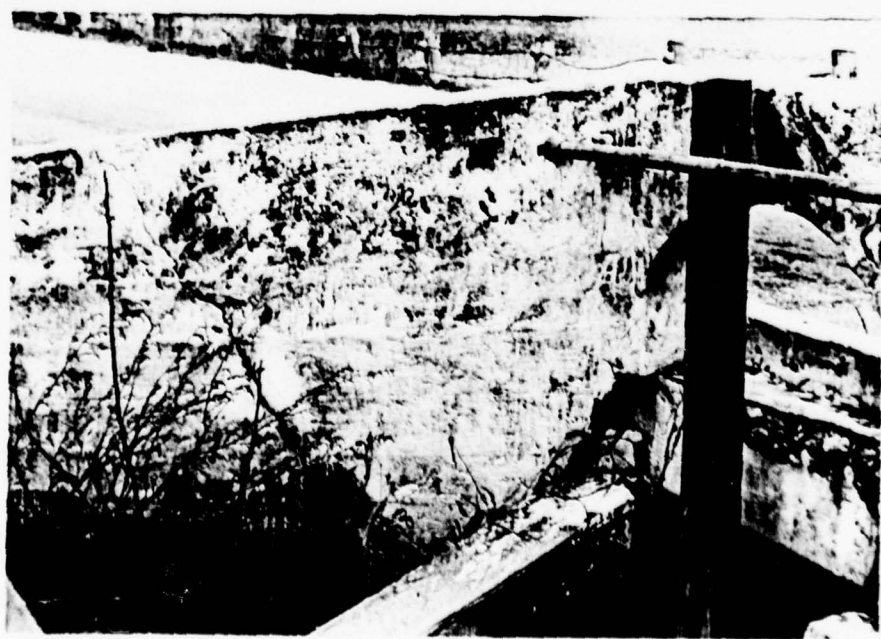


PHOTO 10

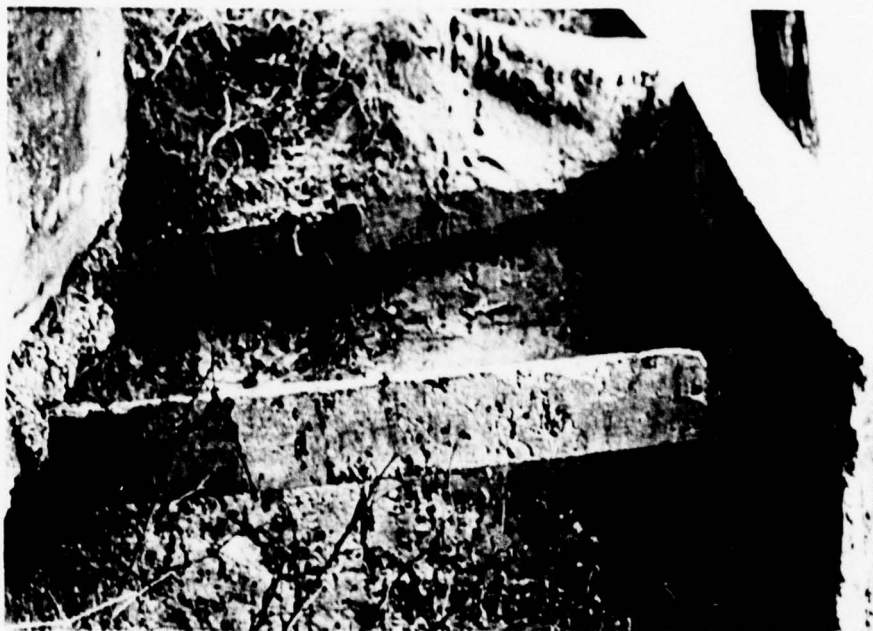


PHOTO 11

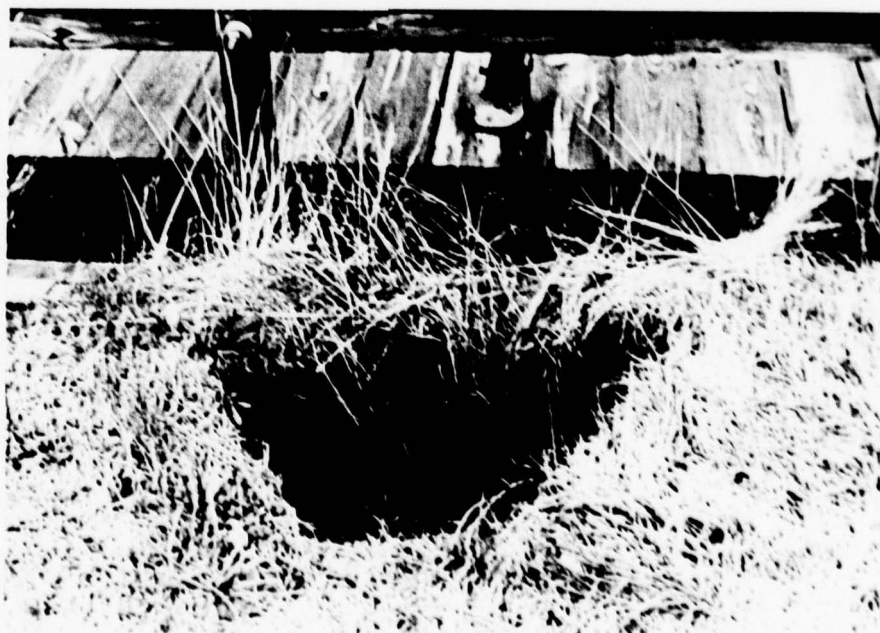


PHOTO 12

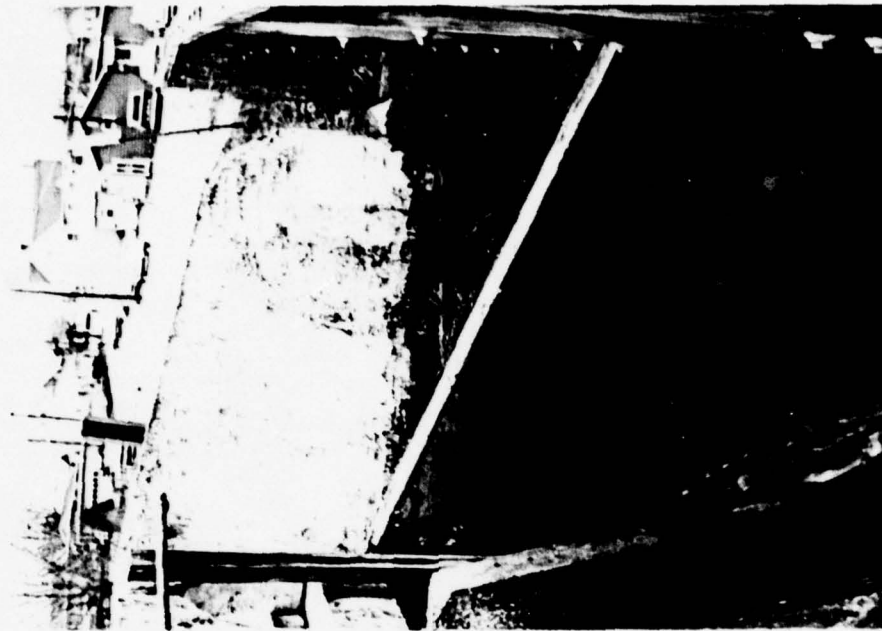


PHOTO 14



PHOTO 13

DETAILED PHOTOGRAPH DESCRIPTIONS

- PHOTO 1 - View of downstream retaining walls - looking south.
- PHOTO 2 - View looking upstream through spillway under bridge.
- PHOTO 3 - View looking southward at columns on downstream side. Note deterioration at low end of first two columns.
- PHOTO 4 - Close-up view of first two columns noted in Photo 3.
- PHOTO 5 - View looking downstream from dam. Note bridge and building structures beyond.
- PHOTO 6 - View of upstream retaining walls - looking south.
- PHOTO 7 - View looking north beyond spillway along embankment.
- PHOTO 8 - View looking south beyond spillway along embankment. Note low point beyond bridge and filled-in mill race on left side.
- PHOTO 9 - View of concrete pier supporting north downstream wingwall. Note lack of foundation and erosion.
- PHOTO 10 - View of cracked and laterally displaced south downstream wingwall.
- PHOTO 11 - View of erosion under upper downstream retaining wall on south side of bridge adjacent to sinkhole. Note supporting structure of lower downstream retaining wall.
- PHOTO 12 - Close-up of 4 feet diameter sinkhole adjacent to retaining wall noted in Photo 11.
- PHOTO 13 - View looking south at spillway retaining wall and cracked wingwall.
- PHOTO 14 - View looking north at spillway retaining wall and wingwall.

NAME OF DAM: WAGAMONS POND DAM

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 22.8 Square Miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 6.5 (153 Acre Ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 12.5 ft. M.S.L. (579 Acre Ft.)

ELEVATION TOP DAM: Min. Elev. 8.6 ft. M.S.L.

CREST: _____

- a. Elevation 5.9 ft. M.S.L. Average (5.4 to 6.5 ft. M.S.L.)
- b. Type Wooden stop logs
- c. Width 1 1/2" +
- d. Length 6 @ 2.75' + = 16.5' total
- e. Location Spillover Over low point in Mulberry St., approx. 350' so. of dam
- f. Number and Type of Gates N/A

OUTLET WORKS: _____

- a. Type Wooden stop logs
- b. Location At main spillway
- c. Entrance inverts 1.1
- d. Exit inverts 1.1
- e. Emergency draindown facilities Stop logs could be removed

HYDROMETEOROLOGICAL GAGES: None

- a. Type _____
- b. Location _____
- c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

APPENDIX D

HYDROLOGIC COMPUTATIONS

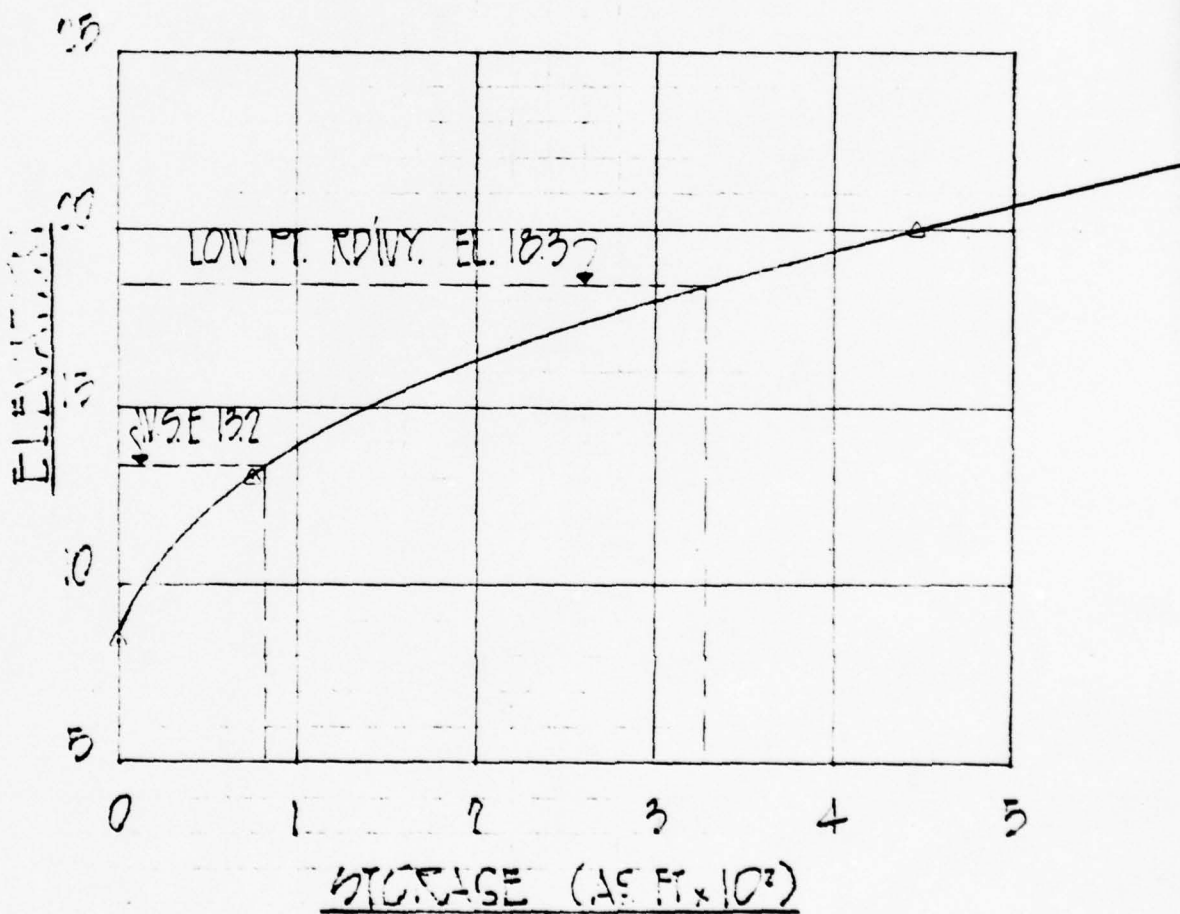


WATERSHED MAP

WAGAMONS POND DAM

THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS

ELEV	AREA (FT ²)	AVG. AREA (FT ²)	DEPTH (FT.)	VOL. (FT ³)	Σ VOL. (FT ³)	Σ VOL. (AC. FT.)
8.3	0	100,000	4.7	3,290,000	0	
13	1,400,000	2,310,000	7.0	16,170,000	3,290,000	15.5
20	3,220,000				19,460,000	446.7



Project N2

20000301

Calculated By AK

Checked By

Date 11/10/99

Date

Calculations For:

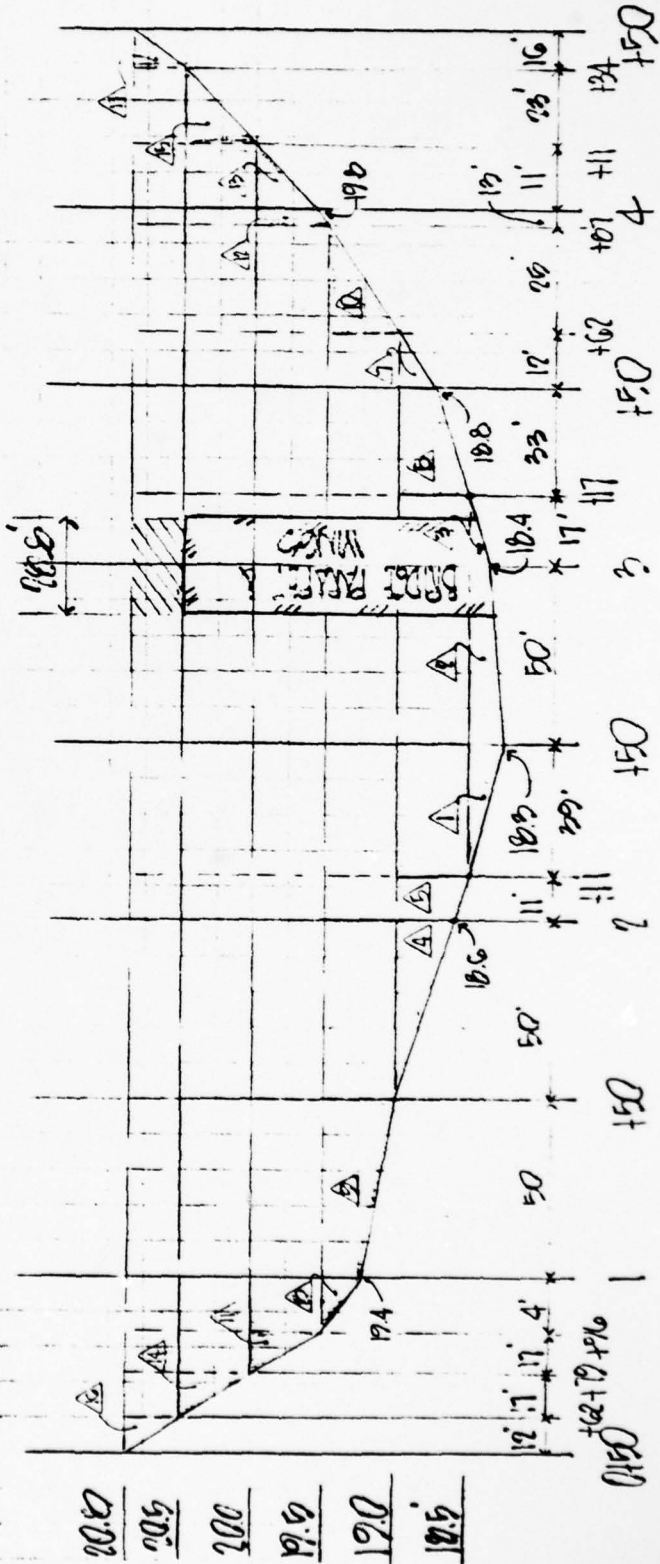
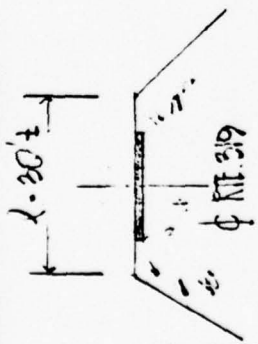
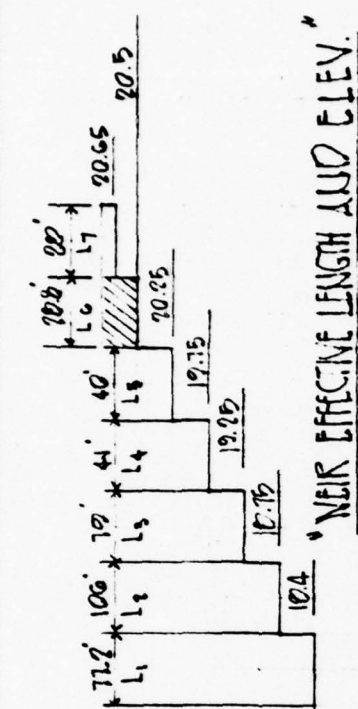
STAGE-STORAGE

DIAMOND STATE POND

(DATA OBTAINED FROM GAUGES)

Sheet 1

Of



Sheet No

Calculated By

Date

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Date

Calculations For:
EFFECTIVE WEIR LENGTH RIE 319
DIAMOND STATE POND
OVER RDIVY FLOW

Sheet

2

Of

Project No

Checked By

Date

 Calculations For:
 BRIDGE DISCHARGE
 DAVENPORT STATE ROAD
 COLLECTING ALL WATER

 Sheet
 01

$$Q = C_d A_o (2g H_o)^{1/2} \text{ (ORIFICE FLOW) } H_o \text{ MEAS. FROM } \phi \text{ OF ORIFICE @ EL 14.7}$$

 NOTE: H_o, C_d, L_1, Q_s SUBSCRIPT DENOTES PRINCIPAL SPILLWAY; H_o, C_d, A_o, Q_s SUBSCRIPT DENOTES BRIDGE ACTING AS AN ORIFICE;

$$Q = C L H^{3/2} \text{ (WEIR FLOW)}$$

 H_1, C_e, L_1, Q_s SUBSCRIPT DENOTES RDWY EMBANKMENT ACTING AS

EL	H_s	H_o	H_1	H_2	H_3	H_4	H_5	H_6	H_7	C_s	C_o	C_e	L_o	A_o	L_1	L_2	L_3	L_4	L_5	L_6	L_7	H_1^*	H_1^* (2910)	H_1^*	H_2^*	H_3^*	H_4^*	H_5^*	H_6^*	H_7^*	Q_s	Q_o
12.0	0									3.3			100									0.0									0	
13.0	0.2																					0.09									3	
14.0	1.2																					1.51									43	
14.7	1.9	0									0.6		38									2.62	0								86	0
15.0	2.2	0.3																				3.26	4.40								108	100
16.0	3.2	1.3																				5.77	9.15								189	209
17.0	4.2	2.3																				8.61	12.17								284	217
18.0	5.2	3.3																				11.86	14.58								391	332
18.4	5.6	3.7	0									2.6			77.7							13.25	15.44	0							437	352
18.75		4.05	0.35	0												106						16.15	0.21	0							360	
19.25		4.55	0.85	0.5	0											79						17.12	0.78	0.35	0						390	
19.75		5.05	1.35	1.0	0.5	0												41				18.03	1.57	1.00	0.35	0					411	
20.25		5.55	1.85	1.50	1.0	0.5	0													40		18.91	2.52	1.84	1.00	0.35	0				431	
20.5		5.80	2.10	1.75	1.25	0.75	0.25	0													28.8	19.33	3.04	2.32	1.40	0.65	0.13	0			441	
20.65		5.95	2.25	1.90	1.40	0.90	0.40	0.15	0													19.57	3.37	2.62	1.66	0.85	0.25	0.06	0		446	
21.0		6.3	2.60	2.25	1.75	1.25	0.75	0.5	0.35													20.14	4.19	3.37	2.32	1.40	0.65	0.35	0.21		459	

Q. CL H^{3/2} (WEIR FLOW)

Q. CL H^{3/2} (WEIR FLOW)

BRIDGE ACTING AS AN ORIFICE,

H₁, C₂, L₁, Q₁ SUBSCRIPT DENOTES RDWY EMBANKMENT ACTING AS A WEIR

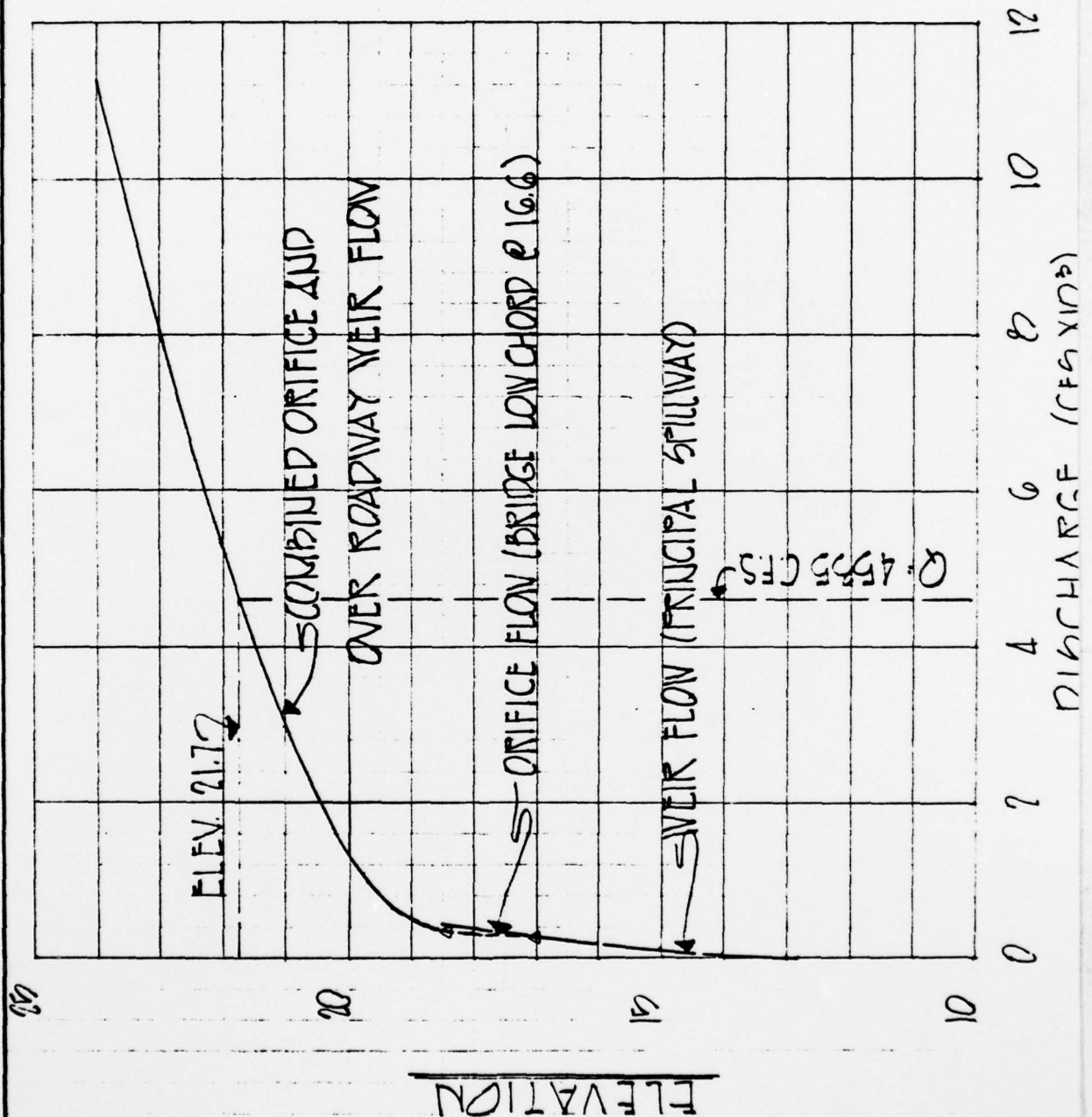
L ₀	L ₄	L ₅	L ₆	L ₇	H ₀ ^{3/2} (29.0)	H ₁ ^{3/2}	H ₂ ^{3/2}	H ₃ ^{3/2}	H ₄ ^{3/2}	H ₅ ^{3/2}	H ₆ ^{3/2}	H ₇ ^{3/2}	Q ₃	Q ₆	Q ₁	Q ₂	Q ₃	Q ₄	Q ₅	Q ₆	Q ₇	Σ Q	COMMENTS
					0.0								0									0	
					0.09								3									3	
					1.31								43									43	
					2.32 0								86	0								86	
					3.26 4.40								108	100								108	
					5.77 9.15								189	209								189	
					8.61 12.17								284	217								277	ORIFICE CONTROL
					11.86 14.58								391	332								332	
					13.25 15.44 0								437	352	0							352	BEGIN RDWY WEIR
					16.15 0.21 0								360	42	0							410	
					17.12 0.78 0.35 0								390	157	97	0						644	
					18.03 1.57 1.00 0.35 0								411	315	276	73	0					1075	
					18.91 2.52 1.84 1.00 0.35 0								431	505	506	205	38	0				1685	
					19.33 3.04 2.32 1.40 0.65 0.13 0							441	611	638	287	69	13	0			2059		
					19.57 3.37 2.62 1.66 0.85 0.25 0.06 0							446	677	722	340	91	26	4	0		2306		
					20.14 4.19 3.37 2.32 1.40 0.65 0.35 0.21							459	841	930	476	149	68	26	15		2964		
79																							
	41																						
		40																					
			288																				
				28																			

THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS

2

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21.68	6.83	5.86	4.56	3.37	2.92	1.84	1.57	494	1371	1615	937	360	841	138	114	5710
23.17	9.87	8.76	7.26	5.86	4.56	3.95	3.60	527	1980	2415	1492	674	474	296	262	8070
24.47	13.25	12.03	10.95	8.76	7.26	6.55	6.13	558	2060	3315	2126	934	755	490	446	11284



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Date

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Date

Calculations For:
STAGE-DISCHARGE
DIAMOND STATE POND
NEGLECTING TAILWATER

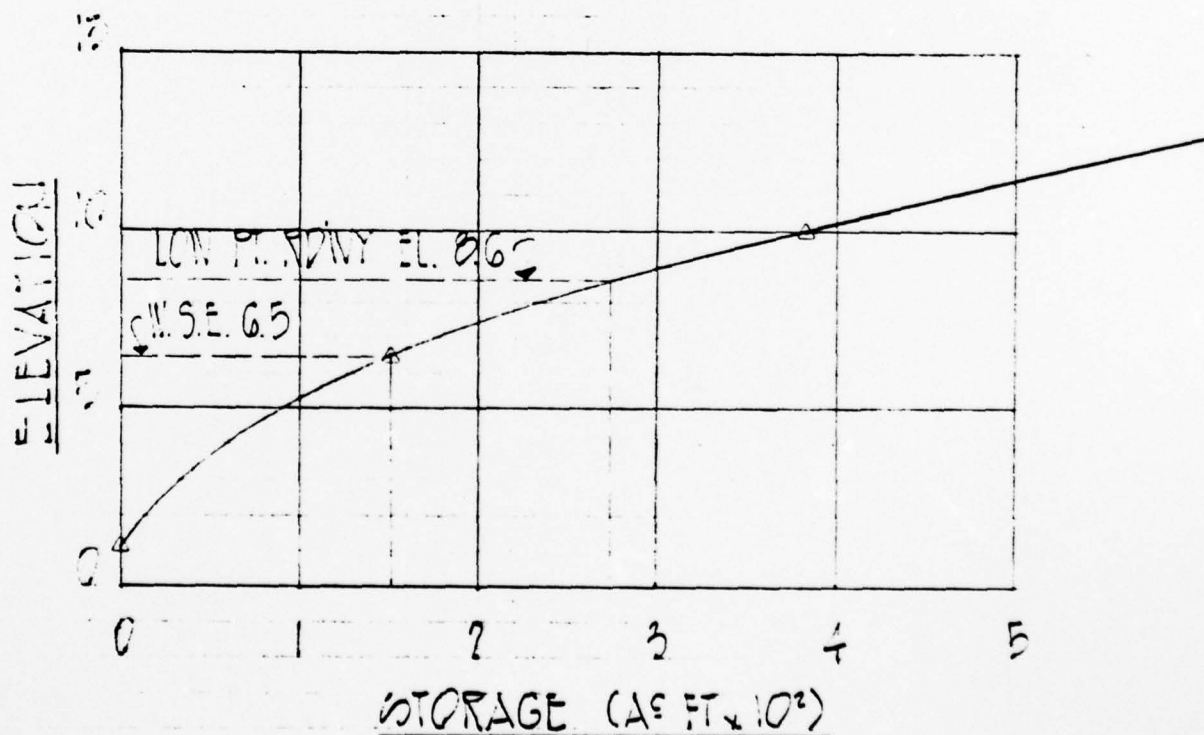
Sheet

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PROFESSIONAL ENGINEERS AND LAND SURVEYORS

ELEV	AREA (FT ²)	AVG. AREA (FT ²)	DEPTH (FT)	VOL. (FT ³)	Σ VOL (FT ³)	Σ VOL. (AC. FT)
1.1	0				0	0
6.5	2,460,000	1,230,000	5.4	6,642,000	6,642,000	152.5
10	3,340,000	2,900,000	3.5	10,150,000	16,792,000	385.5



Sheet No

2012-01

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1/10/79

Date

Date

Calculations For:

STAGE-STORAGE

WAGAMOUS POND

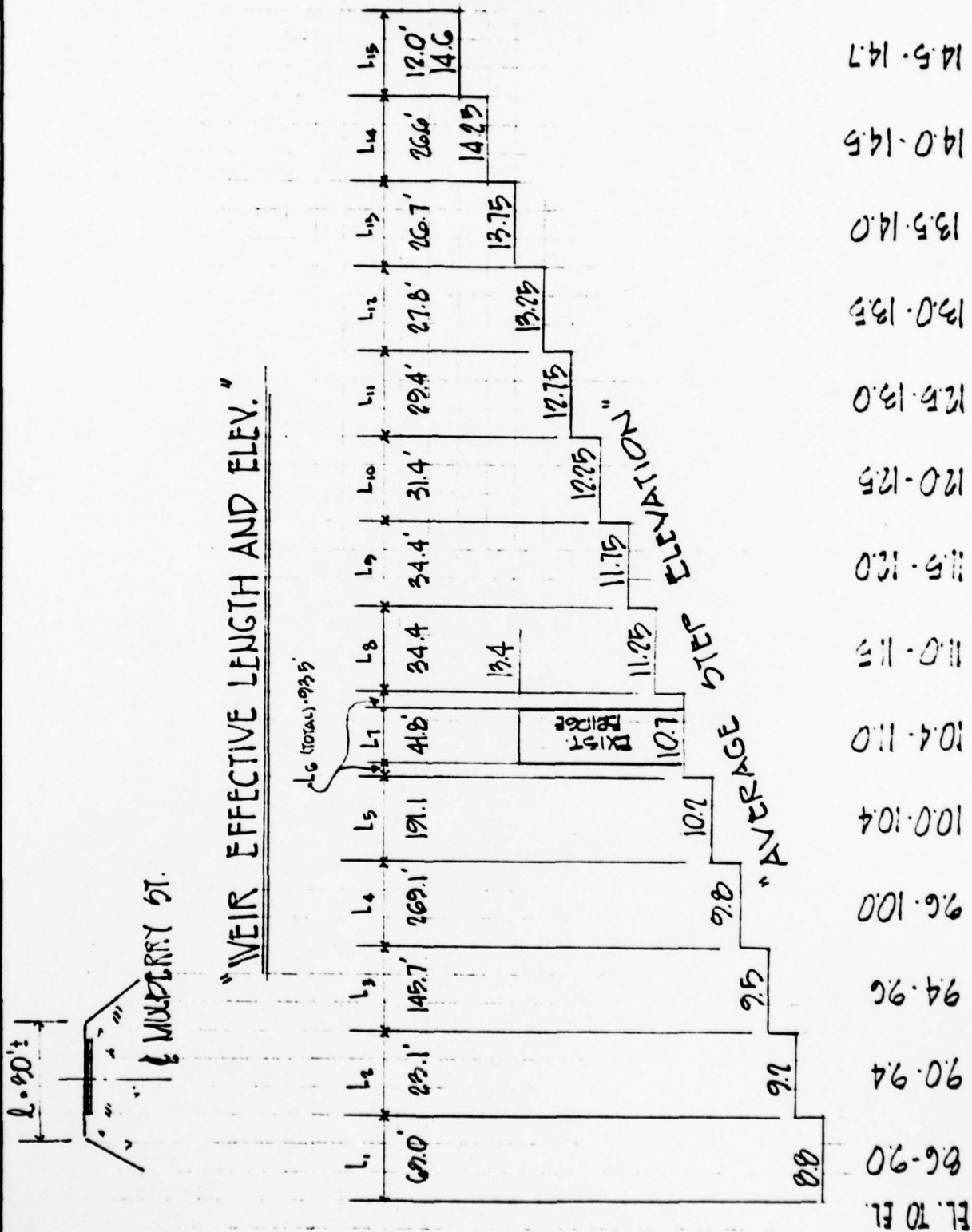
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PROFESSIONAL ENGINEERS AND LAND SURVEYORS



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Date

Calculations For:
EFFECTIVE VEIR LENGTH
MULPERRY STREET
OVER RDWY. FLOW

Sheet

7

Of

Q. CLH* (MUR FLOW)

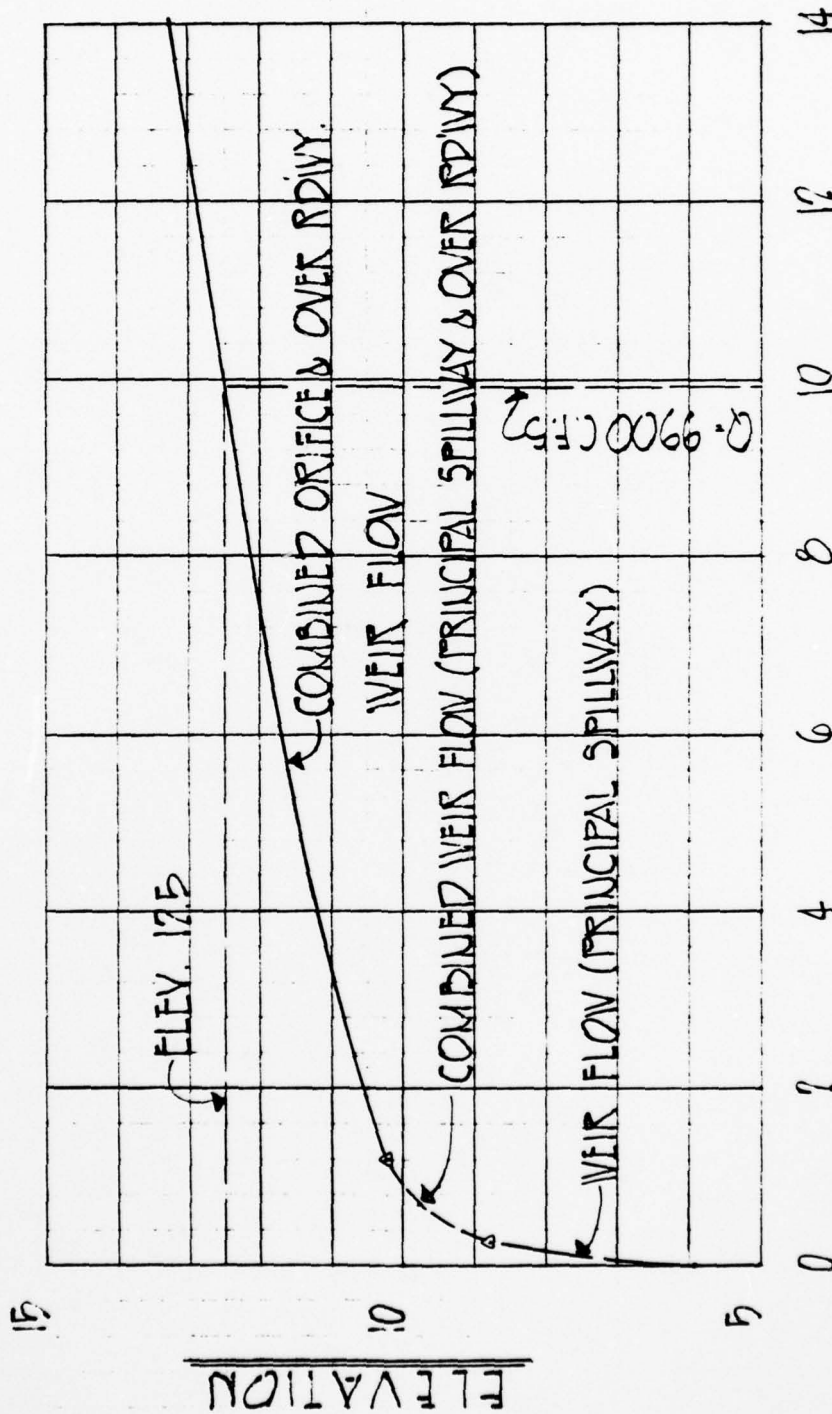
NOTE: H₀L₀L₀G₀ SUBSCRIPT DENOTES PRINCIPAL SPINWAY; H₀L₀L₀G₀ SUBSCRIPT DENOTES BRIDGE ACTING AS AN OFFICE; H₀L₀L₀G₀ SUBSCRIPT DENOTES BRIDGE ACTING AS A

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*DAGU OFFICE COPY

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 1000-10th St., S.W., Room 1000, Seattle, Wash. 98101

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DISCHARGE (CFS $\times 10^3$)

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Date

Calculations For:
STAGE-DISCHARGE
WAGAMONS POND
NEGLECTING TAILWATER

Sheet

2

of

1

DETERMINE HEADWATER (H.W.) ELEVATION UPSTREAM
OF BRIDGE NO. 769 CONSIDERING FLOWS THROUGH THE
BRIDGE UNDER OUTLET CONTROL AND FLOW OVER THE
BRIDGE AS WEIR FLOW.

FOR OUTLET CONTROL:

$$H.W. = T.W + 1.2 V^2 / 2g$$

WHERE T.W ELEV. = 5.0

$$V = Q/A = Q / (7.55 \times 24.5) \approx Q / 185$$

FOR WEIR FLOW: BEGINS @ EL. 6.2

$$Q = CLH^{3/2}$$

USE: C = 2.6

$$L = 30 \text{ FT.}$$

COMPARE H.W. ELEV. DETERMINED FROM ABOVE METHOD
WITH H.W. ELEV. FOUND BY PASSING VARIOUS FLOWS BETWEEN
RESTRICTION CAUSED BY EXISTING BUILDINGS JUST DOWN-
STREAM FROM BRIDGE 769.

NOTE: CALCULATIONS FOR HIGHER FLOWS PRODUCING H.W. ELEV. OVER
THE RDWY (ELEV. 6.2) ARE SUBJECT TO REVISION WHEN A MORE DETAILED
STUDY IS MADE USING ADDITIONAL DATA AFFECTING FLOW BETWEEN
BUILDINGS ALONG UNION STREET.

Project No.

228-03-301

Calculated By
CAR

Checked By

1/10/79
Date

Date

Calculations For:

CONTROLS DOWNSTREAM
OF WAGAMON'S FOND
UNION STREET BRIDGE 769

Sheet

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Q (CFS) THROUGH BRIDGE	Q (CFS) WEIR	HEAD (FT.) ON WEIR	V (FT/SEC) THROUGH BRIDGE	Q (CFS) TOTAL	HEAD/ATE ELEV
500			2.7	500	5.1
1000			5.4	1000	5.5
1500			8.1	1500	6.2
1944	56	0.8	10.5	2000	7.0
2327	173	1.7	12.6	2500	7.9
2654	346	2.7	14.3	3000	8.9
2967	533	3.6	16.0	3500	9.8
3256	744	4.5	17.6	4000	10.7
3522	970	5.4	19.0	4500	11.6

NOTE: CALCULATIONS FOR HIGHER FLOWS PRODUCING H.W. ELEV.
OVER THE RDWY (EL. 6.2) ARE SUBJECT TO REVISION WHEN A
MORE DETAILED STUDY IS MADE USING ADDITIONAL DATA
AFFECTING FLOW BETWEEN BUILDINGS ALONG UNION STREET.

Project No

Calculated By

Date

Calculations For:

Sheet

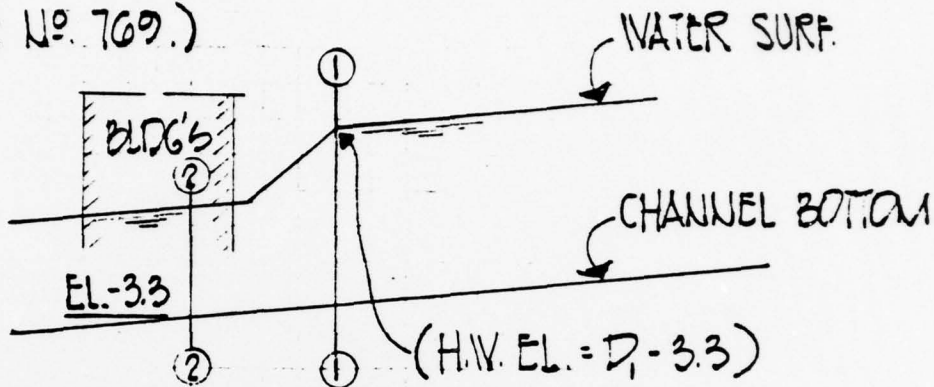
11

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Date

Of

DETERMINE HEADWATER (H.W.) ELEVATION RESULTING
FROM PASSING VARIOUS FLOWS THROUGH CONTROL
SECTION (BETWEEN EXISTING BLDG'S. DOWNSTREAM
OF BRIDGE NO. 769.)



FOR RECTANGULAR SECTION:

$$D_1 = 1.6 (Q / 5.67 B)^{2/3}$$

USE: $B = 25 \text{ FT.}$

MIN H.W. EL. = 5.0* AS SUPPLIED

Sheet No

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Date

Calculations For:

STAGE-DISCHARGE AT
CONTROL SECTION
DOWNSTREAM OF BRIDGE 769

Sheet

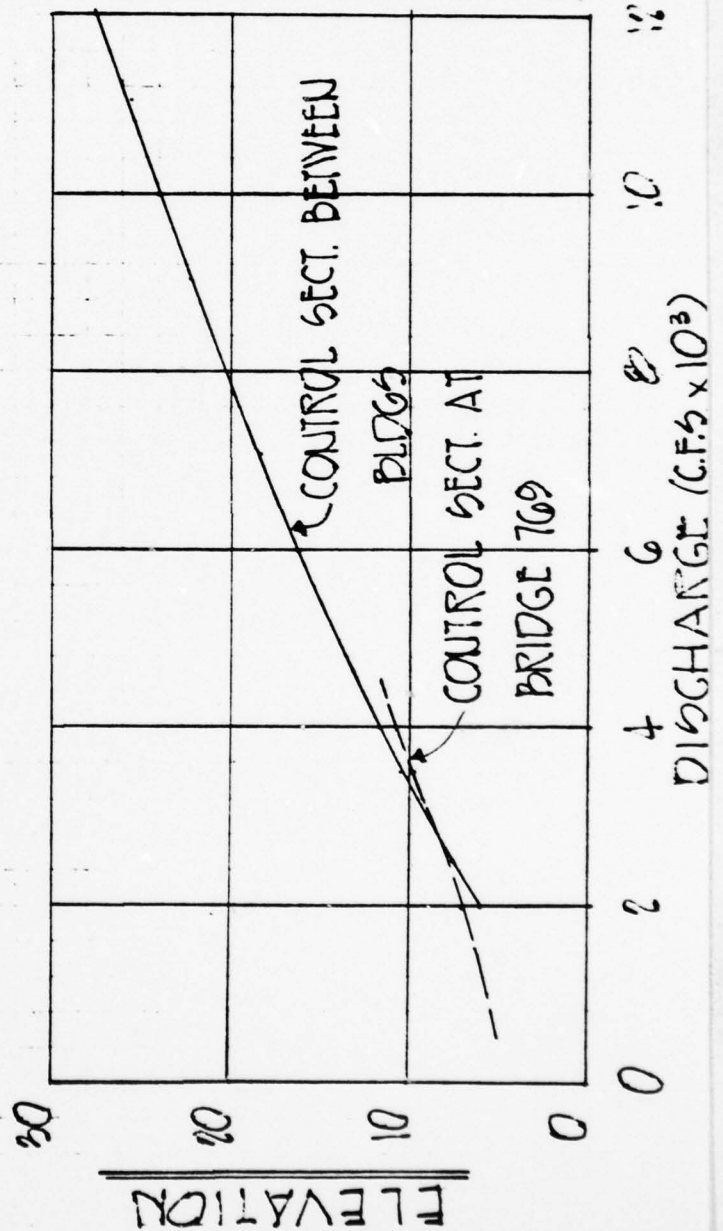
12

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PROFESSIONAL ENGINEERS AND LAND SURVEYORS

Q (ASSUME)	D (CALC)	H.W. ELEV.
500	3.7	5.0*
1000	5.9	5.0*
1500	7.7	5.0*
2000	9.3	6.0
2500	10.8	7.5
3000	12.2	8.9
3500	13.6	10.3
4000	14.8	11.5
4500	16.0	12.7
5000	17.2	13.9
6000	19.4	16.1
7000	21.5	18.2
8000	23.5	20.2
9000	25.5	22.2
10000	27.3	24.0
11000	29.1	25.8
12000	30.8	27.5

NOTE: CALC'S. FOR HIGHER FLOWS PRODUCING
H.W. ELEV. OVER THE RD.WY. (ELEV. 6.2) ARE SUBJECT
TO REVISION WHEN A MORE DETAILED STUDY
IS MADE USING ADDITIONAL DATA AFFECTING FLOW
BETWEEN BUILDINGS ALONG UNION ST.



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Calculations For:

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NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. WAGAMONS POND (DE00061), DELAWARE --ETC(U)
MAR 79 T T MOORE

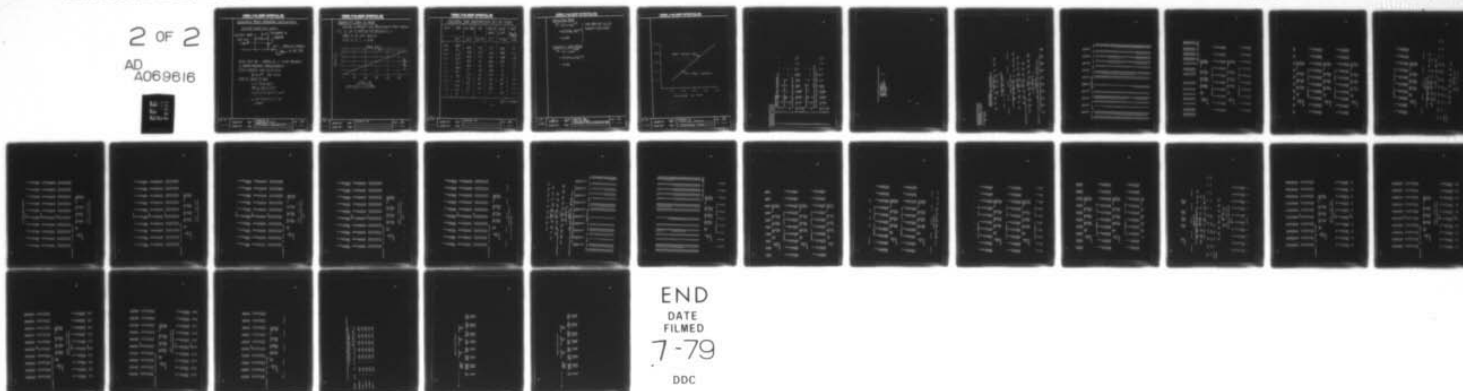
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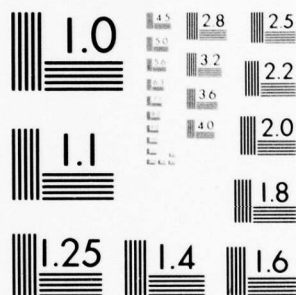
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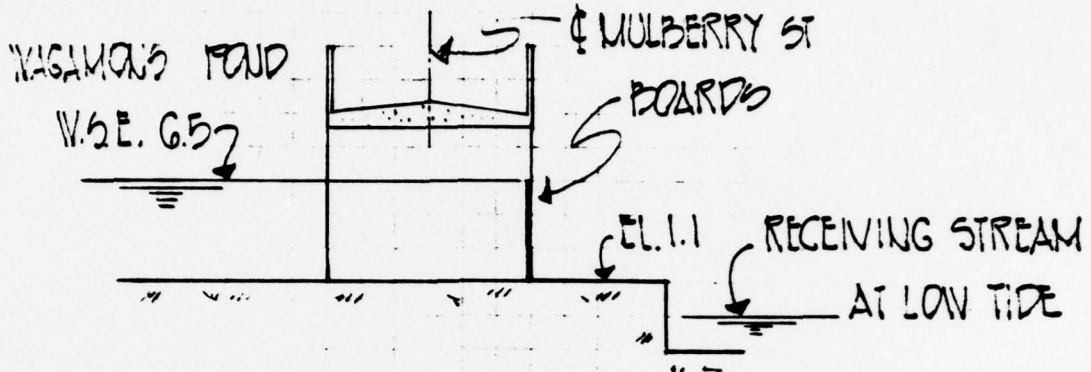
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

VAGAMON'S POND - DRAWDOWN CALCULATIONS

CONSIDER CONDITIONS SHOWN:



INITIAL W.S.E. 6.5 - BOTTOM EL. 1.1 = 5.4 FT DRAWDOWN

ALL BOARDS REMOVED INSTANTANEOUSLY

BROAD-CRESTED WEIR CONDITIONS:

$$Q = CLH^{3/2} \quad \text{USE } C = 2.6$$

EFFECTIVE LENGTH OF WEIR:

$$L = L' - 2(NK_p + K_e)H_e$$

FOR H_e USE AVG. CF = 2.1

$$L = 16.5, N = 5, K_p = 0.00, K_e = 0.00$$

$$\therefore L = 16.5 - 2(5 \times 0.00 + 0.00) 2.1$$

$$= 14.9 \text{ FT.}$$

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Date

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Date

Calculations For:

VAGAMON'S POND
DRAWDOWN CALCULATIONS

Sheet 14

Of

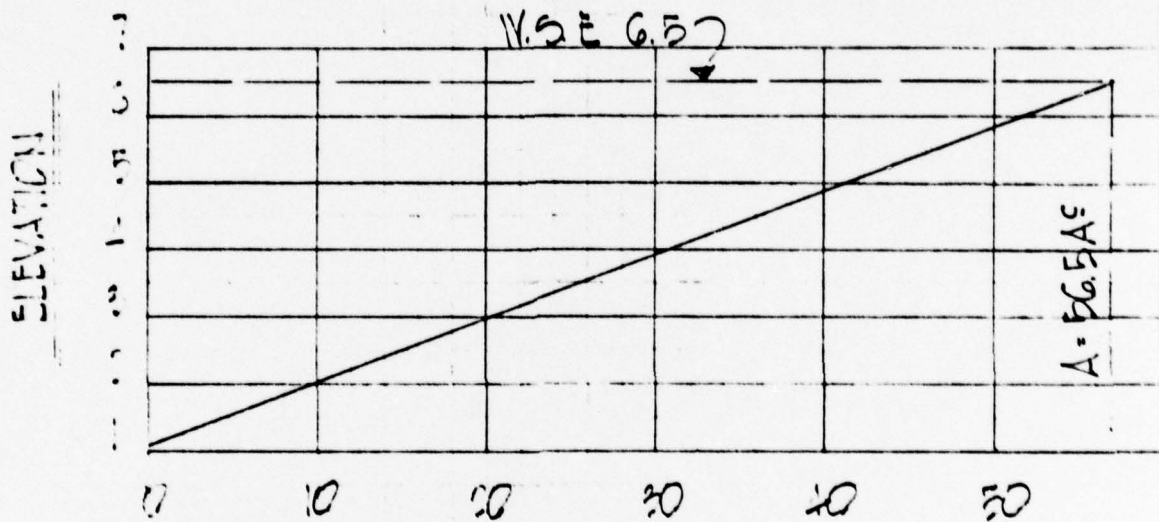
THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS

RESERVOIR AREA VS. HEAD

ASSUME A STRAIGHT LINE RELATIONSHIP FROM NORMAL
POOL EL. 6.5 TO BOTTOM OF SPILLWAY EL. 1.1

AREA AT EL. 6.5 = 56.5 AS

AREA AT EL. 1.1 = 0 AS



AREA - AS
 $AREA = (ELEV - 1.1) / 0.0956$

1 N2

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Date

Calculations For:

Sheet

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DRAINAGE TIME COMPUTATIONS WITH NO INFLOW

ELEV.	AREA	AVG. AREA	VOL	HEAD ON OUTLET	OUTLET Q. CH ³ /S	TIME $\frac{VOL \times 24}{1.48 \times Q}$
	(AC)	(AC)	(AC. FT)	(FT)	FT ³ /SEC	(HRS)
6.5	56.5	53.9	270	5.15	453	0.72
6.0	51.2	48.6	243	4.65	388	0.76
5.5	46.0	43.4	217	4.15	328	0.80
5.0	40.8	38.2	191	3.65	270	0.86
4.5	35.6	33.0	165	3.15	217	0.92
4.0	30.3	27.7	139	2.65	167	1.01
3.5	25.1	22.5	113	2.15	112	1.12
3.0	19.9	17.3	87	1.65	82	1.29
2.5	14.6	12.0	60	1.15	48	1.52
2.0	9.4	6.8	34	0.65	10	2.06
1.5	4.2	2.1	10	0.2	3.5	3.46
1.1	0					

--- ZT = 14.5 HR. ---

ect N^o

Calculated By

Date

Calculations For:

Sheet

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Checked By

Date

Of

VAGAMONS FOND

$$T.P. = C_t(L + L_{c2})^{0.3}$$

$$= 3.0(5.54 + 2.51)^{0.3}$$

$$= 6.6 \text{ HR.}$$

TIME DOES NOT INCLUDE
DIAMOND STATE FOND

DIAMOND STATE FOND

$$T.P. = C_t(L + L_{c2})^{0.3}$$

$$= 3.0(32.76 + 4.76)^{0.3}$$

$$= 9.2 \text{ HR}$$

100

ct No

203-301

Calculated By
CAR

Checked By

12/78
Date

Date

Calculations For:

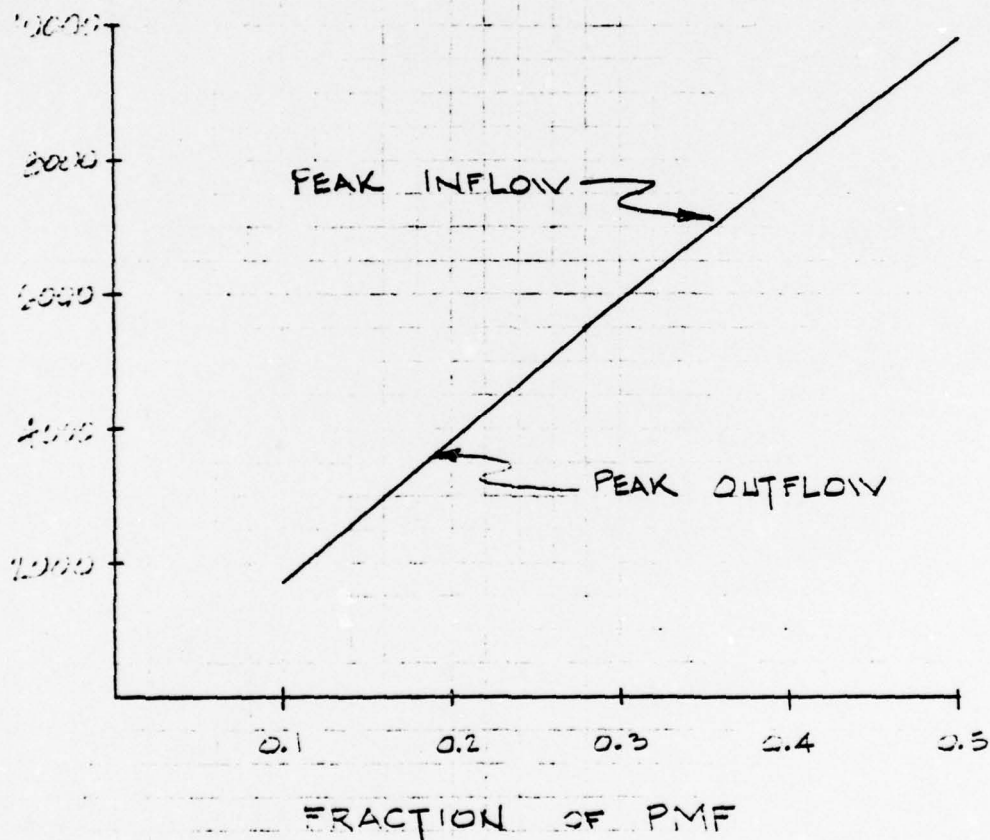
TIME TO PEAK

VAGAMONS FOND & DIAMOND STATE

Sheet 17

of

THOMAS TYLER MOORE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS



ect N^o

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2-21-79

Date

Calculations For:

ROUTING SUMMARY

Sheet

187

of

Checked By

Date

WAGAMONS POND

.....
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 21 AUG 78

WAGAMONS POND DAM		PHASE I DAM INSPECTION -- STATE OF DELAWARE		PATRICK A. KENNEDY, THOMAS TYLER MOORE ASSOCIATES	
1	A1	120	0	30	0
2	A2	5	1	5	1
3	A3	1	0	0	0
4	B1	1	0	0	0
5	B2	1	0	0	0
6	C1	1	0	0	0
7	C2	1	0	0	0
8	D1	1	0	0	0
9	D2	1	0	0	0
10	E1	1	0	0	0
11	E2	1	0	0	0
12	F1	1	0	0	0
13	F2	1	0	0	0
14	G1	1	0	0	0
15	G2	1	0	0	0
16	H1	1	0	0	0
17	H2	1	0	0	0
18	I1	1	0	0	0
19	I2	1	0	0	0
20	J1	1	0	0	0
21	J2	1	0	0	0
22	K1	1	0	0	0
23	K2	1	0	0	0
24	L1	1	0	0	0
25	L2	1	0	0	0
26	M1	1	0	0	0
27	M2	1	0	0	0
28	N1	1	0	0	0
29	N2	1	0	0	0
30	O1	1	0	0	0
31	O2	1	0	0	0
32	P1	1	0	0	0
33	P2	1	0	0	0
34	Q1	1	0	0	0
35	Q2	1	0	0	0
36	R1	1	0	0	0
37	R2	1	0	0	0
38	S1	1	0	0	0
39	S2	1	0	0	0
40	T1	1	0	0	0
41	T2	1	0	0	0
42	U1	1	0	0	0
43	U2	1	0	0	0
44	V1	1	0	0	0
45	V2	1	0	0	0
46	W1	1	0	0	0
47	W2	1	0	0	0
48	X1	1	0	0	0
49	X2	1	0	0	0
50	Y1	1	0	0	0
51	Y2	1	0	0	0
52	Z1	1	0	0	0
53	Z2	1	0	0	0
54	AA1	1	0	0	0
55	AA2	1	0	0	0
56	AB1	1	0	0	0
57	AB2	1	0	0	0
58	AC1	1	0	0	0
59	AC2	1	0	0	0
60	AD1	1	0	0	0
61	AD2	1	0	0	0
62	AE1	1	0	0	0
63	AE2	1	0	0	0
64	AF1	1	0	0	0
65	AF2	1	0	0	0
66	AG1	1	0	0	0
67	AG2	1	0	0	0
68	AH1	1	0	0	0
69	AH2	1	0	0	0
70	AI1	1	0	0	0
71	AI2	1	0	0	0
72	AJ1	1	0	0	0
73	AJ2	1	0	0	0
74	AK1	1	0	0	0
75	AK2	1	0	0	0
76	AL1	1	0	0	0
77	AL2	1	0	0	0
78	AM1	1	0	0	0
79	AM2	1	0	0	0
80	AN1	1	0	0	0
81	AN2	1	0	0	0
82	AO1	1	0	0	0
83	AO2	1	0	0	0
84	AP1	1	0	0	0
85	AP2	1	0	0	0
86	AQ1	1	0	0	0
87	AQ2	1	0	0	0
88	AR1	1	0	0	0
89	AR2	1	0	0	0
90	AS1	1	0	0	0
91	AS2	1	0	0	0
92	AT1	1	0	0	0
93	AT2	1	0	0	0
94	AU1	1	0	0	0
95	AU2	1	0	0	0
96	AV1	1	0	0	0
97	AV2	1	0	0	0
98	AW1	1	0	0	0
99	AW2	1	0	0	0
100	AX1	1	0	0	0
101	AX2	1	0	0	0
102	AY1	1	0	0	0
103	AY2	1	0	0	0
104	AZ1	1	0	0	0
105	AZ2	1	0	0	0
106	BA1	1	0	0	0
107	BA2	1	0	0	0
108	BB1	1	0	0	0
109	BB2	1	0	0	0
110	BC1	1	0	0	0
111	BC2	1	0	0	0
112	BD1	1	0	0	0
113	BD2	1	0	0	0
114	BE1	1	0	0	0
115	BE2	1	0	0	0
116	BF1	1	0	0	0
117	BF2	1	0	0	0
118	BG1	1	0	0	0
119	BG2	1	0	0	0
120	BH1	1	0	0	0
121	BH2	1	0	0	0
122	BI1	1	0	0	0
123	BI2	1	0	0	0
124	BJ1	1	0	0	0
125	BJ2	1	0	0	0
126	BK1	1	0	0	0
127	BK2	1	0	0	0
128	BL1	1	0	0	0
129	BL2	1	0	0	0
130	BM1	1	0	0	0
131	BM2	1	0	0	0
132	BN1	1	0	0	0
133	BN2	1	0	0	0
134	BO1	1	0	0	0
135	BO2	1	0	0	0
136	BP1	1	0	0	0
137	BP2	1	0	0	0
138	BQ1	1	0	0	0
139	BQ2	1	0	0	0
140	BR1	1	0	0	0
141	BR2	1	0	0	0
142	BS1	1	0	0	0
143	BS2	1	0	0	0
144	BT1	1	0	0	0
145	BT2	1	0	0	0
146	BU1	1	0	0	0
147	BU2	1	0	0	0
148	BV1	1	0	0	0
149	BV2	1	0	0	0
150	BW1	1	0	0	0
151	BW2	1	0	0	0
152	BX1	1	0	0	0
153	BX2	1	0	0	0
154	BY1	1	0	0	0
155	BY2	1	0	0	0
156	BZ1	1	0	0	0
157	BZ2	1	0	0	0
158	CA1	1	0	0	0
159	CA2	1	0	0	0
160	CB1	1	0	0	0
161	CB2	1	0	0	0
162	CC1	1	0	0	0
163	CC2	1	0	0	0
164	CD1	1	0	0	0
165	CD2	1	0	0	0
166	CE1	1	0	0	0
167	CE2	1	0	0	0
168	CF1	1	0	0	0
169	CF2	1	0	0	0
170	CG1	1	0	0	0
171	CG2	1	0	0	0
172	CH1	1	0	0	0
173	CH2	1	0	0	0
174	CI1	1	0	0	0
175	CI2	1	0	0	0
176	CJ1	1	0	0	0
177	CJ2	1	0	0	0
178	CK1	1	0	0	0
179	CK2	1	0	0	0
180	CL1	1	0	0	0
181	CL2	1	0	0	0
182	CM1	1	0	0	0
183	CM2	1	0	0	0
184	CN1	1	0	0	0
185	CN2	1	0	0	0
186	CO1	1	0	0	0
187	CO2	1	0	0	0
188	CP1	1	0	0	0
189	CP2	1	0	0	0
190	CQ1	1	0	0	0
191	CQ2	1	0	0	0
192	CR1	1	0	0	0
193	CR2	1	0	0	0
194	CS1	1	0	0	0
195	CS2	1	0	0	0
196	CT1	1	0	0	0
197	CT2	1	0	0	0
198	CU1	1	0	0	0
199	CU2	1	0	0	0
200	CV1	1	0	0	0
201	CV2	1	0	0	0
202	CW1	1	0	0	0
203	CW2	1	0	0	0
204	CX1	1	0	0	0
205	CX2	1	0	0	0
206	CY1	1	0	0	0
207	CY2	1	0	0	0
208	CZ1	1	0	0	0
209	CZ2	1	0	0	0
210	DA1	1	0	0	0
211	DA2	1	0	0	0
212	DB1	1	0	0	0
213	DB2	1	0	0	0
214	DC1	1	0	0	0
215	DC2	1	0	0	0
216	DD1	1	0	0	0
217	DD2	1	0	0	0
218	DE1	1	0	0	0
219	DE2	1	0	0	0
220	DF1	1	0	0	0
221	DF2	1	0	0	0
222	DG1	1	0	0	0
223	DG2	1	0	0	0
224	DH1	1	0	0	0
225	DH2	1	0	0	0
226	DI1	1	0	0	0
227	DI2	1	0	0	0
228	DJ1	1	0	0	0
229	DJ2	1	0	0	0
230	DK1	1	0	0	0
231	DK2	1	0	0	0
232	DL1	1	0	0	0
233	DL2	1	0	0	0
234	DM1	1	0	0	0
235	DM2	1	0	0	0
236	DN1	1	0	0	0
237	DN2				

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
RUNOFF HYDROGRAPH AT	3
COMBINE 2 HYDROGRAPHS AT	4
ROUTE HYDROGRAPH TO	5
END OF NETWORK	

.....
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 21 AUG 78

RUN DATE= 79/02/13-
 TIME= 09.23-20.

WAGANONS POND DAM
 PHASE I DAM INSPECTION -- STATE OF DELAWARE
 PATRICK A. KENNEDY, THOMAS TYLER MOORE ASSOCIATES

JOB SPECIFICATION									
NQ	NHR	NNIN	IDAY	IMR	IMIN	METRC	IPLT	IPRT	NSTAN
120	0	30	0	0	0	0	0	0	0
	JOPER		NMT	LROPT	TRACE				
	5		0	0	0				

MULTI-PLAN ANALYSES TO BE PERFORMED
 MPLAN= 1 NRTO= 5 LRTIO= 1
 RTIOS= .10 .20 .30 .40 .50

..... SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO DIAMOND STATE POND

ISTAO	JCOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA									
INYDG	IUMG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	11.67	0.00	11.67	0.00	0.000	0	1	0

PRECIP DATA			
SPFE	PMS	R6	R72
0.00	25.00	105.00	115.00

TRSPC COMPUTED BY THE PROGRAM IS .805

LOSS DATA									
LROPT	STRKR	OLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSKA
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00

UNIT HYDROGRAPH DATA
 TP= 9.20 CP= .50 NTA= 0

RECESSION DATA
 SRTIO= 0.00 ORCSN= 0.00 RTIOR= 1.00
 APPROXIMATE C-ARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=19.12 AND R=25.14 INTERVALS

UNIT HYDROGRAPH-100 END-OF-PERIOD ORIGINATES, LAG= 9.24 HOURS, CP= .50 VOL= .97									
241.	19.	39.	63.	90.	120.	152.	185.	220.	256.
379.	322.	349.	312.	336.	391.	406.	416.	422.	410.
344.	379.	366.	350.	336.	323.	310.	298.	287.	276.

0															
MO,DA	HR,MN	PERIOD	RAIN	EXCS	LOSS	COMP 0	END-OF-PERIOD FLOW			HR,MN	PERIOD	RAIN	EXCS	LOSS	COMP 0
									MO,DA						
255.	178.	254.	245.	235.	226.	217.	209.	200.	193.	185.					
119.	115.	110.	106.	102.	98.	94.	90.	87.	84.						
40.	37.	34.	31.	28.	25.	22.	19.	16.	13.						
54.	52.	50.	48.	46.	44.	42.	40.	38.	36.						
36.	35.	33.	32.	30.	29.	27.	25.	23.	21.						
24.	23.	22.	21.	20.	19.	18.	17.	16.	15.						
1.01	1.30	1	0.01	0.00	0.	1.02	6.30	61	17	0.03					
1.01	1.00	2	0.01	0.00	0.	1.02	7.00	62	17	0.03					
1.01	1.30	3	0.01	0.00	0.	1.02	7.30	63	17	0.03					
1.01	2.00	4	0.01	0.00	0.	1.02	8.00	64	17	0.03					
1.01	2.30	5	0.01	0.00	0.	1.02	8.30	65	17	0.03					
1.01	3.00	6	0.01	0.00	0.	1.02	9.00	66	17	0.03					
1.01	3.30	7	0.01	0.00	0.	1.02	9.30	67	17	0.03					
1.01	4.00	8	0.01	0.00	0.	1.02	10.00	68	17	0.03					
1.01	4.30	9	0.01	0.00	0.	1.02	10.30	69	17	0.03					
1.01	5.00	10	0.01	0.00	0.	1.02	11.00	70	17	0.03					
1.01	5.30	11	0.01	0.00	0.	1.02	11.30	71	17	0.03					
1.01	6.00	12	0.01	0.00	0.	1.02	12.00	72	17	0.03					
1.01	6.30	13	0.02	0.00	0.02	1.02	12.30	73	1.06	1.03	0.02				
1.01	7.00	14	0.02	0.00	0.02	1.02	13.00	74	1.06	1.03	0.02				
1.01	7.30	15	0.02	0.00	0.02	1.02	13.30	75	1.27	1.24	0.02				
1.01	8.00	16	0.02	0.00	0.02	1.02	14.00	76	1.27	1.24	0.02				
1.01	8.30	17	0.02	0.00	0.02	1.02	14.30	77	1.59	1.56	0.02				
1.01	9.00	18	0.02	0.00	0.02	1.02	15.00	78	1.59	1.56	0.02				
1.01	9.30	19	0.02	0.00	0.02	1.02	15.30	79	1.93	1.90	0.02				
1.01	10.00	20	0.02	0.00	0.02	1.02	16.00	80	6.11	6.08	0.03				
1.01	10.30	21	0.02	0.00	0.02	1.02	16.30	81	1.48	1.45	0.02				
1.01	11.00	22	0.02	0.00	0.02	1.02	17.00	82	1.48	1.45	0.02				
1.01	11.30	23	0.02	0.00	0.02	1.02	17.30	83	1.16	1.14	0.02				
1.01	12.00	24	0.02	0.00	0.02	1.02	18.00	84	1.16	1.14	0.02				
1.01	12.30	25	0.10	0.00	0.10	1.02	18.30	85	0.09	0.07	0.03				
1.01	13.00	26	0.10	0.00	0.10	1.02	19.00	86	0.09	0.07	0.03				
1.01	13.30	27	0.12	0.00	0.12	1.02	19.30	87	0.09	0.07	0.03				
1.01	14.00	28	0.12	0.00	0.12	1.02	20.00	88	0.09	0.07	0.03				
1.01	14.30	29	0.15	0.00	0.15	1.02	20.30	89	0.09	0.07	0.03				
1.01	15.00	30	0.15	0.02	0.14	1.02	21.00	90	0.09	0.07	0.03				
1.01	15.30	31	0.15	0.16	0.13	1.02	21.30	91	0.09	0.07	0.03				
1.01	16.00	32	0.59	0.57	0.02	1.02	22.00	92	0.09	0.07	0.03				
1.01	16.30	33	0.14	0.12	0.03	1.02	22.30	93	0.09	0.07	0.03				
1.01	17.00	34	0.14	0.12	0.03	1.02	23.00	94	0.09	0.07	0.03				
1.01	17.30	35	0.11	0.09	0.03	1.02	23.30	95	0.09	0.07	0.03				
1.01	18.00	36	0.11	0.09	0.03	1.03	24.00	96	0.09	0.07	0.03				
1.01	18.30	37	0.01	0.00	0.01	1.03	25.00	97	0.00	0.00	0.00				
1.01	19.00	38	0.01	0.00	0.01	1.03	26.00	98	0.00	0.00	0.00				
1.01	19.30	39	0.01	0.00	0.01	1.03	27.00	99	0.00	0.00	0.00				
1.01	20.00	40	0.01	0.00	0.01	1.03	28.00	100	0.00	0.00	0.00				
1.01	20.30	41	0.01	0.00	0.01	1.03	29.00	101	0.00	0.00	0.00				
1.01	21.00	42	0.01	0.00	0.01	1.03	30.00	102	0.00	0.00	0.00				
1.01	21.30	43	0.01	0.00	0.01	1.03	31.00	103	0.00	0.00	0.00				
1.01	22.00	44	0.01	0.00	0.01	1.03	32.00	104	0.00	0.00	0.00				
1.01	22.30	45	0.01	0.00	0.01	1.03	33.00	105	0.00	0.00	0.00				
1.01	23.00	46	0.01	0.00	0.01	1.03	34.00	106	0.00	0.00	0.00				
1.01	23.30	47	0.01	0.00	0.01	1.03	35.00	107	0.00	0.00	0.00				
1.02	0.00	48	0.01	0.00	0.01	1.03	36.00	108	0.00	0.00	0.00				
1.02	0.30	49	0.04	0.04	0.03	1.03	37.00	109	0.00	0.00	0.00				

PEAK OUTFLOW IS 1797. AT TIME 49.00 HOURS									
OUTFLOW									
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
7.	10.	12.	14.	17.	19.	21.	23.	26.	26.
20.	32.	33.	35.	37.	38.	39.	41.	42.	42.
43.	45.	47.	48.	50.	52.	54.	56.	60.	60.
63.	66.	69.	72.	76.	81.	86.	94.	104.	116.
133.	153.	178.	210.	249.	286.	317.	351.	377.	400.
137.	144.	153.	164.	171.	176.	179.	179.	178.	175.
170.	167.	162.	157.	152.	147.	142.	136.	130.	124.
1201.	1155.	1111.	1069.	1030.	1000.	963.	927.	891.	857.
STORAGE									
76.	76.	76.	76.	76.	76.	76.	76.	75.	75.
75.	75.	75.	75.	75.	75.	75.	75.	75.	75.
75.	75.	75.	75.	75.	75.	75.	75.	75.	75.
74.	74.	74.	74.	74.	74.	74.	74.	74.	74.
62.	84.	86.	88.	91.	94.	97.	100.	103.	106.
109.	111.	114.	116.	119.	121.	123.	124.	126.	128.
129.	131.	132.	134.	135.	137.	138.	140.	142.	144.
140.	149.	151.	154.	157.	161.	166.	172.	179.	188.
174.	212.	228.	247.	270.	297.	327.	361.	395.	423.
441.	451.	458.	463.	467.	470.	472.	471.	470.	470.
466.	465.	453.	459.	456.	453.	450.	446.	444.	441.
439.	437.	435.	433.	431.	429.	427.	425.	422.	420.
STAGE									
13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
13.1	13.1	13.2	13.2	13.3	13.3	13.3	13.4	13.5	13.6
13.6	13.7	13.7	13.8	13.8	13.8	13.9	13.9	13.9	14.0
14.0	14.1	14.1	14.1	14.1	14.1	14.2	14.2	14.2	14.3
14.0	14.4	14.4	14.5	14.5	14.6	14.7	14.8	14.9	15.1
14.3	15.0	15.0	15.2	15.2	15.2	15.2	15.2	15.2	15.2
14.9	20.1	20.1	20.2	20.3	20.3	20.3	20.3	20.3	20.3
20.3	20.2	20.2	20.2	20.1	20.1	20.0	20.0	20.0	20.0
19.9	19.8	19.8	19.7	19.7	19.7	19.6	19.6	19.5	19.5

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
1797.	1699.	943.	387.	46466.
51.	48.	27.	11.	1316.
	1.35	3.01	3.09	3.09
	34.50	76.35	78.40	78.40
	84.3	187.6	1920.	1920.
	1039.	2306.	2306.	2306.

STATION 2. PLAN 1.0 RATIO 3
END-OF-PERIOD HYDROGRAPH ORIGINATES

PEAK OUTFLOW IS 2703. AT TIME 49.00 HOURS									
OUTFLOW									
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
10.	13.	15.	18.	21.	24.	28.	31.	35.	38.
41.	45.	49.	53.	57.	60.	63.	66.	69.	71.
74.	76.	78.	80.	82.	85.	88.	91.	94.	98.
102.	107.	112.	118.	125.	133.	143.	156.	171.	190.
212.	247.	283.	313.	348.	381.	411.	442.	475.	510.
2107.	2281.	2429.	2541.	2621.	2674.	2701.	2703.	2679.	2631.
2567.	2493.	2413.	2330.	2253.	2177.	2100.	2026.	1955.	1884.
1814.	1744.	1680.	1624.	1565.	1507.	1449.	1393.	1327.	1267.
STORAGE									
76.	76.	76.	76.	76.	76.	76.	76.	75.	75.
75.	75.	75.	75.	75.	75.	75.	75.	75.	75.
74.	74.	74.	74.	74.	74.	74.	74.	73.	73.
86.	89.	92.	96.	100.	104.	109.	113.	118.	122.
126.	131.	134.	138.	141.	144.	147.	149.	151.	153.
155.	157.	159.	161.	163.	165.	167.	170.	172.	175.
174.	181.	185.	188.	193.	199.	205.	213.	223.	235.
251.	270.	294.	323.	358.	396.	428.	450.	465.	477.
497.	496.	502.	504.	510.	512.	513.	513.	512.	510.
507.	504.	501.	498.	494.	491.	487.	484.	480.	476.
473.	469.	466.	462.	459.	455.	451.	448.	445.	442.
STAGE									
13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
13.0	13.0	13.0	13.0	12.9	12.9	12.9	12.9	12.9	12.9
12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
12.9	12.9	12.9	12.9	13.0	13.0	13.0	13.0	13.1	13.1
13.2	13.2	13.3	13.4	13.5	13.5	13.6	13.7	13.8	13.9
14.0	14.0	14.1	14.2	14.2	14.3	14.3	14.4	14.4	14.5
14.5	14.5	14.6	14.6	14.6	14.7	14.7	14.8	14.8	14.9
14.9	15.0	15.0	15.1	15.2	15.3	15.4	15.6	15.8	16.0
16.3	16.7	17.1	17.7	18.3	19.0	19.6	20.2	20.8	20.8
20.5	20.6	20.7	20.7	20.8	20.8	20.9	20.9	20.8	20.8
20.6	20.7	20.7	20.7	20.6	20.6	20.5	20.5	20.4	20.4
20.3	20.3	20.2	20.2	20.2	20.1	20.1	20.0	20.0	19.9

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
2703.	2563.	1488.	611.	7339.
77.	73.	42.	17.	2077.
CFS	2.04	4.74	4.87	4.87
INCHES	51.89	120.52	123.74	123.74
MM	1271.	2952.	3031.	3031.
AC-FT	1568.	3641.	3738.	3738.
THOUS CU 4				

STATION 2. PLAN 1. RATIO 4
 END-OF-PERIOD HYDROGRAPH ORIGINATES
 OUTFLOW

[illegible]

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
CFS	3609.	3429.	2030.	834.	100133.
CMS	97.	97.	57.	24.	2895.
INCHES	102.	97.	57.	24.	2895.
M4		2.73	6.47	6.65	6.65
		69.42	164.43	168.95	168.95
AC-FT		4138.	4027.	4138.	4138.
THOUS CU Y		2097.	4967.	5104.	5104.

STATION 2, PLAN 1. RATIO 5
END-OF-PERIOD HYDROGRAPH ORDINATES

PEAK OUTFLOW IS 4511. AT TIME 48.50 HOURS									
4.	2.	2.	2.	2.	2.	2.	2.	2.	2.
75.	75.	75.	75.	75.	75.	75.	75.	75.	75.
75.	75.	75.	75.	75.	75.	75.	75.	75.	75.
74.	74.	74.	74.	74.	74.	74.	74.	74.	74.
93.	93.	93.	93.	93.	93.	93.	93.	93.	93.
161.	161.	161.	161.	161.	161.	161.	161.	161.	161.
203.	203.	203.	203.	203.	203.	203.	203.	203.	203.
233.	233.	233.	233.	233.	233.	233.	233.	233.	233.
350.	350.	350.	350.	350.	350.	350.	350.	350.	350.
544.	544.	544.	544.	544.	544.	544.	544.	544.	544.
565.	565.	565.	565.	565.	565.	565.	565.	565.	565.
521.	521.	521.	521.	521.	521.	521.	521.	521.	521.
13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4
16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1
18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2
21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3
21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5
21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5
21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9
13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2
15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2
17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.7
21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6
21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6
20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5

PEAK OUTFLOW IS 4511. AT TIME 48.50 HOURS

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
4511.	4281.	2573.	1058.	127008.
128.	121.	73.	30.	3596.
	3.41	8.21	8.44	8.44
	86.68	208.41	214.29	214.29
	2123.	5104.	5248.	5248.
	2619.	6296.	6474.	6474.

..... SUB-AREA RUNOFF COMPUTATION

INFLU HYDROGRAPH TO WAGAMONS POND

ISTAQ ICOMP IECON ITAPE JPLT JPRY INAME ISTAGE IAUTO
3 0 0 0 0 1 0 0

HYDQ IUNG TAREA SNAP TRSDA TRSPC RATIO ISNOW ISAME LOCAL
1 1 11.16 0.00 11.16 0.00 0.000 0 1 1 0

PRECIP DATA

SPFE PMS R6 R12 R24 R48 R72 R96
0.00 25.00 105.00 115.00 124.00 136.00 0.00 0.00

TRSPC COMPUTED BY THE PROGRAM IS .804

LOSS DATA
LWOPT STKR DLTKR RTLOL ERAIN STRKS ATLOK STRTL CNSTL ALSMA RTIMP
0 0.00 0.00 1.00 0.00 0.00 1.00 1.00 .05 0.00 0.00

UNIT HYDROGRAPH DATA
TP= 6.60 CP= .50 NTA= 0

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=13.84 AND R=18.00 INTERVALS
RECESSION DATA
STRTD= 0.00 ORCSN= 0.00 RTIOR= 1.00
UNIT HYDROGRAPH DATA
LAG= 6.61 HOURS, CP= .50 VOL= .99

UNIT	HYDROGRAPH	END-OF-PERIOD	COORDINATES	LAG	6.61 HOURS	CP	.50	VOL	.99
11.	40.	83.	134.	190.	252.	317.	381.	431.	484.
521.	546.	560.	574.	588.	602.	616.	630.	644.	658.
383.	362.	343.	324.	307.	290.	274.	259.	243.	228.
220.	208.	197.	186.	176.	166.	157.	149.	141.	133.
126.	119.	113.	107.	101.	95.	90.	85.	81.	76.
72.	68.	65.	61.	58.	55.	52.	49.	46.	44.
41.	39.	37.	35.	33.	31.	30.	28.	27.	25.
24.	23.	21.	20.	19.	18.	17.	16.	15.	14.
14.	13.	12.	11.	10.	9.	8.	7.	6.	5.
8.	7.	6.	5.	4.	3.	2.	1.	0.	0.

MO.DA	HR.MN	PERIOD	RAIY	EXCS	LOSS	END-OF-PERIOD	FLOW	MO.DA	HR.MN	PERIOD	RAIY	EXCS	LOSS	COMP
1.01	1.30	1	.01	0.00	.01	0.00	1.02	6.30	61	.17	.14	.03	420.	
1.01	1.00	2	.01	0.00	.01	0.00	1.02	7.00	62	.17	.14	.03	428.	
1.01	1.30	3	.01	0.00	.01	0.00	1.02	7.30	63	.17	.14	.03	442.	
1.01	2.00	4	.01	0.00	.01	0.00	1.02	8.00	64	.17	.14	.03	461.	
1.01	2.30	5	.01	0.00	.01	0.00	1.02	8.30	65	.17	.14	.03	485.	
1.01	3.00	6	.01	0.00	.01	0.00	1.02	9.00	66	.17	.14	.03	516.	
1.01	3.30	7	.01	0.00	.01	0.00	1.02	9.30	67	.17	.14	.03	554.	
1.01	4.00	8	.01	0.00	.01	0.00	1.02	10.00	68	.17	.14	.03	598.	
1.01	4.30	9	.01	0.00	.01	0.00	1.02	10.30	69	.17	.14	.03	648.	
1.01	5.00	10	.01	0.00	.01	0.00	1.02	11.00	70	.17	.14	.03	703.	
1.01	5.30	11	.01	0.00	.01	0.00	1.02	11.30	71	.17	.14	.03	762.	
1.01	6.00	12	.01	0.00	.01	0.00	1.02	12.00	72	.17	.14	.03	823.	
1.01	6.30	13	.02	0.00	.02	0.00	1.02	12.30	73	1.06	1.03	.02	895.	
1.01	7.00	14	.02	0.00	.02	0.00	1.02	13.00	74	1.06	1.03	.02	993.	
1.01	7.30	15	.02	0.00	.02	0.00	1.02	13.30	75	1.27	1.24	.02	1129.	
1.01	8.00	16	.02	0.00	.02	0.00	1.02	14.00	76	1.27	1.24	.02	1312.	
1.01	8.30	17	.02	0.00	.02	0.00	1.02	14.30	77	1.58	1.56	.02	1556.	
1.01	9.00	18	.02	0.00	.02	0.00	1.02	15.00	78	1.58	1.56	.02	1871.	
1.01	9.30	19	.02	0.00	.02	0.00	1.02	15.30	79	1.92	1.90	.02	2269.	
1.01	10.00	20	.02	0.00	.02	0.00	1.02	16.00	80	6.09	6.07	.03	2806.	
1.01	10.30	21	.02	0.00	.02	0.00	1.02	16.30	81	1.48	1.45	.02	3512.	
1.01	11.00	22	.02	0.00	.02	0.00	1.02	17.00	82	1.48	1.45	.02	4347.	

THOUS CU 4	HYDROGRAPH AT STA				3 FOR PLAN 1, RTIO 4				4702.
	0.	0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6.	16.	31.	50.	73.	99.	127.	150.	182.	0.
22.	239.	240.	25.	246.	230.	220.	211.	206.	0.
180.	180.	175.	170.	167.	165.	165.	165.	166.	0.
168.	171.	184.	194.	206.	221.	239.	259.	281.	0.
305.	329.	350.	451.	525.	622.	740.	900.	1123.	0.
1405.	1739.	2111.	2508.	2916.	3315.	3680.	4237.	4414.	0.
4519.	4505.	4390.	4234.	4060.	3875.	3689.	3508.	3335.	0.
3169.	3011.	2800.	2574.	2440.	2312.	2189.	2071.	1960.	0.
1854.	1753.	1659.	1404.	1404.	1320.	1256.	1100.	1124.	0.

THOUS CU 4	PEAK	TOTAL VOLUME		
		6-HOUR	72-HOUR	TOTAL VOLUME
4550.	4172.	2409.	1025.	122986.
129.	110.	68.	29.	3483.
		0.03	0.54	0.54
	88.32	204.02	216.99	216.99
	2069.	4778.	5082.	5082.
	2551.	5894.	6269.	6269.

THOUS CU 4	CF5	CM5	INCHES	M4	AC-FT	THOUS CU 4

[illegible]

COMBINE HYDROGRAPHS

[illegible]

199. 204. 211. 218. 228. 240. 250. 270. 309.
 331. 353. 380. 410. 444. 527. 610. 717. 1031.
 1269. 1551. 1866. 2194. 2535. 3027. 3741. 4418. 5218.
 5496. 5893. 5808. 5834. 5797. 5719. 5608. 5449. 5132.
 4944. 4751. 4360. 4184. 4007. 3833. 3667. 3509. 3356.
 3205. 3061. 2924. 2801. 2678. 2560. 2445. 2335. 2110.

PEAK 5834. 24-HOUR 3295. 72-HOUR 1380. TOTAL VOLUME 165580.
 CFS 5498. 93. 39. 4689.
 CMS 156. 5.37 5.62 5.62
 INCHES 2-24 136.40 142.81 142.81
 M4 56.90 6535. 6842. 6842.
 AC-FT 2126. 8061. 8440. 8440.
 THOUS CU 4 3363.

SUM OF 2 HYDROGRAPHS AT 4 PLAN 1 RTIO 4
 3. 3. 3. 3.
 2. 2. 2. 2.
 2. 2. 2. 2.
 7. 18. 53. 77. 104. 134. 164. 192. 260.
 241. 259. 272. 279. 275. 269. 264. 260. 260.
 254. 252. 252. 253. 256. 259. 263. 260. 260.
 273. 280. 288. 312. 328. 347. 369. 421. 421.
 480. 516. 563. 626. 710. 821. 964. 1145. 1386.
 1694. 2050. 2459. 3048. 4784. 5454. 6074. 7066. 7066.
 7604. 7720. 7802. 7809. 7749. 7638. 7484. 7294. 6835.
 6321. 6061. 5805. 5491. 5304. 5088. 4884. 4447. 4447.
 4057. 3882. 3710. 3544. 3369. 3238. 3093. 2954. 2821.

PEAK 7809. 24-HOUR 4439. 72-HOUR 1659. TOTAL VOLUME 223121.
 CFS 7373. 126. 53. 6318.
 CMS 221. 7.24 7.58 7.58
 INCHES 3.00 183.78 192.43 192.43
 M4 76.31 8805. 9220. 9220.
 AC-FT 3656. 10861. 11373. 11373.
 THOUS CU 4 4510.

SUM OF 2 HYDROGRAPHS AT 4 PLAN 1 RTIO 5
 3. 3. 3. 3.
 2. 2. 2. 2.
 2. 2. 2. 2.
 9. 22. 41. 66. 96. 130. 167. 204. 240.
 301. 324. 340. 348. 348. 344. 340. 335. 330.
 325. 321. 321. 322. 325. 328. 332. 337. 343.
 350. 368. 381. 391. 417. 440. 467. 497. 531.
 567. 605. 650. 709. 788. 894. 1033. 1211. 1428.
 2097. 3415. 4403. 5281. 6132. 6948. 7696. 8407. 8904.
 9304. 9586. 9736. 9685. 9548. 9355. 9118. 8845. 8543.
 8225. 7901. 7577. 7256. 6944. 6643. 6352. 6071. 5801.
 5624. 4834. 4621. 4414. 4215. 4024. 3846. 3678. 3515.

PEAK 9757. 24-HOUR 5585. 72-HOUR 4340. TOTAL VOLUME 240743.
 CFS 9225. 158. 56. 1950.
 CMS 276. 261.

PEAK OUTFLOW IS 1678. AT TIME 50.00 HOURS

THOUS CU 4

STATION

STORAGE

140.	140.	141.	142.	143.	146.	149.	152.	156.
161.	172.	178.	184.	190.	196.	201.	206.	210.
211.	220.	223.	225.	228.	230.	235.	237.	237.
239.	242.	247.	249.	252.	255.	259.	263.	268.
275.	278.	291.	299.	308.	319.	332.	348.	365.
385.	398.	413.	425.	437.	444.	461.	493.	501.
506.	512.	517.	517.	515.	514.	511.	508.	505.
501.	497.	490.	486.	483.	479.	471.	471.	467.
463.	459.	453.	450.	447.	444.	441.	438.	435.
6.5	6.4	6.4	6.3	6.3	6.3	6.3	6.2	6.2
6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.1
6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
6.0	6.0	6.1	6.1	6.2	6.2	6.3	6.5	6.5
6.6	6.7	6.8	7.0	7.1	7.1	7.2	7.3	7.4
7.4	7.5	7.5	7.6	7.6	7.7	7.7	7.7	7.8
7.8	7.8	7.9	8.0	8.0	8.0	8.1	8.2	8.2
8.3	8.4	8.6	8.7	8.8	9.0	9.2	9.4	9.7
10.0	10.2	10.4	10.7	10.8	11.0	11.2	11.4	11.5
11.6	11.7	11.7	11.7	11.7	11.6	11.6	11.6	11.5
11.5	11.4	11.3	11.3	11.2	11.2	11.1	11.1	11.0
11.0	10.9	10.9	10.8	10.8	10.8	10.7	10.7	10.6

PEAK OUTFLOW IS 5821. AT TIME 47.00 HOURS

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
5821.	5491.	3216.	1323.	158781.
165.	155.	91.	37.	4496.
	2.24	5.24	5.39	5.39
	56.83	133.15	136.95	136.95
	2723.	6380.	6561.	6561.
	3359.	7869.	8093.	8093.

THOUS CU 4

STATION 5. PLAN 1. RATIO 4
END-OF-PERIOD HYDROGRAPH ORDINATES

30.	14.	8.	5.	47.	142.	150.	145.	142.	140.	162.
28.	26.	24.	22.	20.	19.	17.	16.	15.		
14.	13.	12.	11.	11.	10.	10.	9.	9.		
8.	7.	7.	7.	6.	6.	6.	5.	5.		
5.	5.	5.	5.	4.	4.	4.	3.	3.		
47.	54.	73.	85.	10.	21.	30.	36.	41.		
142.	157.	163.	170.	176.	182.	188.	194.	198.		
205.	210.	222.	228.	236.	243.	252.	262.	277.		
299.	323.	379.	424.	474.	509.	561.	598.	688.		
1300.	1752.	2133.	2657.	3411.	4287.	5138.	6379.	6889.		
7271.	7592.	7778.	7808.	7776.	7565.	7373.	7166.	6934.		
6684.	6167.	5923.	5642.	5392.	5184.	4974.	4759.	4548.		
4344.	3981.	3811.	3642.	3481.	3329.	3180.	3038.	2901.		
151.	150.	149.	148.	147.	147.	146.	145.	145.		
145.	144.	144.	143.	143.	143.	142.	142.	142.		
142.	141.	141.	141.	141.	141.	141.	140.	140.		
140.	140.	141.	143.	145.	148.	152.	156.	162.		

169.	176.	184.	192.	201.	208.	216.	222.	228.	234.
239.	247.	251.	258.	264.	268.	270.	270.	270.	270.
314.	320.	327.	334.	342.	351.	361.	372.	383.	394.
407.	420.	431.	447.	466.	486.	503.	516.	527.	535.
544.	557.	570.	581.	590.	599.	608.	616.	624.	631.
532.	528.	523.	519.	513.	508.	504.	500.	496.	492.
468.	460.	454.	447.	441.	436.	432.	428.	424.	420.
6.5	6.4	6.4	6.4	6.3	6.3	6.3	6.3	6.2	6.2
6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.1
6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
6.0	6.0	6.1	6.1	6.1	6.2	6.3	6.5	6.6	6.6
6.7	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7
7.8	7.9	8.0	8.0	8.0	8.1	8.1	8.2	8.2	8.3
8.3	8.3	8.4	8.4	8.5	8.5	8.6	8.7	8.7	8.8
8.9	9.0	9.1	9.2	9.4	9.5	9.6	9.8	10.0	10.1
10.3	10.4	10.6	10.8	11.0	11.3	11.5	11.7	11.8	11.9
12.0	12.1	12.1	12.1	12.1	12.1	12.1	12.0	12.0	11.9
11.9	11.8	11.7	11.7	11.6	11.6	11.5	11.5	11.4	11.4
11.3	11.3	11.2	11.2	11.1	11.1	11.0	11.0	10.9	10.9

PEAK OUTFLOW IS 7808. AT TIME 47.00 HOURS

STATION	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
PEAK	7353.	4372.	1799.	215866.
1808.	208.	124.	51.	6113.
221.	3.00	7.13	7.33	7.33
CFS	76.20	181.01	186.18	186.18
CMS	3651.	8673.	8920.	8920.
INCHES	4503.	10697.	11003.	11003.
M4				
AC-FT				
THOUS CU 4				

STATION 5. PLAN 1. RATIO 5
END-OF-PERIOD HYDROGRAPH ORIGINATES

STATION	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
15.	15.	15.	15.	15.
9.	9.	9.	9.	9.
5.	5.	5.	5.	5.
40.	40.	40.	40.	40.
176.	176.	176.	176.	176.
260.	260.	260.	260.	260.
407.	407.	407.	407.	407.
1457.	1457.	1457.	1457.	1457.
8790.	8790.	8790.	8790.	8790.
8659.	8659.	8659.	8659.	8659.
5665.	5665.	5665.	5665.	5665.
3611.	3611.	3611.	3611.	3611.
145.	145.	145.	145.	145.
142.	142.	142.	142.	142.
140.	140.	140.	140.	140.
161.	161.	161.	161.	161.
168.	168.	168.	168.	168.
257.	257.	257.	257.	257.

263.	269.	274.	278.	282.	286.	290.	294.	297.	301.
304.	307.	311.	314.	317.	321.	325.	329.	334.	339.
344.	350.	355.	361.	367.	374.	381.	389.	396.	404.
421.	435.	454.	476.	497.	515.	530.	544.	556.	564.
570.	578.	586.	594.	599.	607.	614.	621.	627.	634.
559.	555.	549.	544.	538.	533.	528.	524.	519.	514.
508.	503.	499.	495.	491.	487.	483.	479.	475.	471.
STAGE									
6.5	6.4	6.4	6.4	6.3	6.3	6.3	6.3	6.2	6.2
6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.1
6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
6.0	6.0	6.1	6.1	6.2	6.3	6.4	6.5	6.6	6.7
6.9	7.0	7.2	7.3	7.5	7.6	7.7	7.9	8.0	8.1
4.2	8.2	8.3	8.4	8.5	8.5	8.6	8.6	8.7	8.7
4.8	8.8	8.9	8.9	9.0	9.0	9.1	9.2	9.2	9.3
9.4	9.5	9.6	9.6	9.7	9.8	9.9	10.1	10.2	10.3
10.5	10.6	10.9	11.2	11.4	11.7	11.9	12.0	12.2	12.3
12.4	12.4	12.5	12.5	12.5	12.5	12.4	12.4	12.3	12.3
12.2	12.2	12.1	12.0	12.0	11.9	11.8	11.8	11.7	11.6
11.6	11.5	11.5	11.4	11.4	11.3	11.3	11.2	11.1	11.1

PEAK OUTFLOW IS 9755. AT TIME 47.00 HOURS

PEAK	9755.	9219.	5524.	2276.	273066.
CFS	276.	261.	156.	64.	7732.
CMS		3.76	9.00	9.27	235.51
INCHES		95.42	228.68	11284.	11284.
AC-FT		4572.	10957.	13918.	13918.
THOUS CU 4		5639.	13515.		

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS				
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5
				.10	.20	.30	.40	.50
HYDROGRAPH AT	1	11.67 (30.23)	1	905.	1810.	2715.	3620.	4525.
				(25.63)	(51.26)	(76.89)	(102.52)	(128.14)
ROUTED TO	2	11.67 (30.23)	1	844.	1797.	2703.	3609.	4511.
				(23.89)	(50.87)	(76.53)	(102.19)	(127.73)
HYDROGRAPH AT	3	11.16 (28.90)	1	1130.	2275.	3413.	4550.	5688.
				(32.21)	(64.42)	(96.63)	(128.85)	(161.06)
2 COMBINED	4	22.83 (59.13)	1	1694.	3338.	5034.	6709.	8377.
				(47.96)	(108.69)	(165.19)	(221.13)	(276.30)
ROUTED TO	5	22.83 (59.13)	1	1678.	3332.	5021.	6696.	8355.
				(47.53)	(108.51)	(164.84)	(221.10)	(276.23)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	RATIO OF PH ²	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
		13.00	12.80	18.30	.10	19.48	1.10	420.	644.	13.00	50.50	0.00
		76.	73.	357.	.20	20.32	2.02	472.	1797.	16.50	49.00	0.00
		3.	0.	347.	.30	20.86	2.56	513.	2703.	18.00	49.00	0.00
					.40	21.24	2.94	542.	3609.	19.50	48.50	0.00
					.50	21.65	3.35	574.	4511.	19.50	48.50	0.00

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 6.50 153. 33.	SPILLWAY CREST 5.90 136. 0.	TOP OF DAM 8.60 292. 243.	RATIO OF PMF	MAXIMUM RESERVOIR W.S.-ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
					.10	10.41	1.81	417.	1678.	18.00	50.00	0.00
					.20	11.16	2.56	476.	3032.	20.50	47.50	0.00
					.30	11.68	3.08	517.	5821.	23.00	47.00	0.00
					.40	12.12	3.52	551.	7608.	27.00	47.00	0.00
					.50	12.48	3.88	579.	9755.	31.50	47.00	0.00